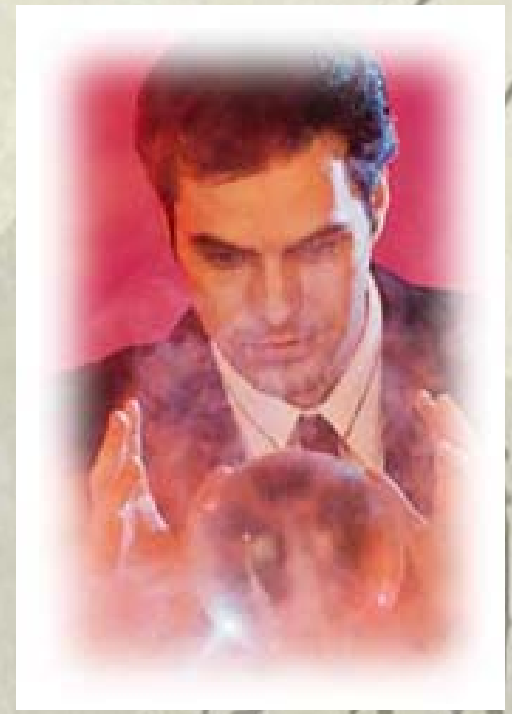
Oil and Natural Gas Forecasting:

Plumbing the Numbers and Connecting Some Dots



The Future of Food Processing Conference

December 10, 2003

Steve Andrews

A little different flavor

- **Residential sector**
- **Renewables**
- **Supply side—connecting dots**

Forecasting

- Relies on data, preferably ***good*** data
- Both demand- and supply-side data *and* analysis—a systems approach
- Short-term forecasts vs. long-term scenarios
- World oil data notoriously bad (M.E.)
- US natural gas data slow to arrive, cause disagreement in advance
- Just two for-the-record long-term forecasts
- Educated bets, short term and long (L.V.)
- US DOE EIA's awful track record

- **Information and misinformation**
- ***Conventional wisdom*** **is based on fuzzy math**
- **Error range: *50%-70%%***
- **Gas CEOs' annual breakfast club bet**

Thursday, December 3, 1998 Jaye Hakes / EIA THE DENVE

...ow fuel prices could linger

Effects of Asia crisis seen as long-term

By Allen R. Myerson
The New York Times

DALLAS — Asia's economic collapse will depress oil and gasoline prices for nearly a decade, saving motorists in the United States about 13 cents a gallon in 2000 alone, the Energy Department said.

While the Asian crisis has already helped to lower energy costs, the report offers by far the strongest evidence that the effects will be deep and long-lasting.

In the United States, continued low energy prices are likely to limit inflation, economists say. Weak ... demand and heavy global ... duction also reduce the nation's ...erability to any sudden disruption of oil imports, which account for about half of U.S. demand.

But the low oil and gasoline prices also hamper the fight against global warming.

With oil at $13 or $15 a barrel, there are few economic incentives for saving energy or using renewable energy sources to reduce pollution that is blamed for global warming.

The oil glut has also resulted from falling production costs and the opening of new regions. The Energy Department expects higher production from the Caspian Sea, the North Sea and the waters off West Africa, as well as from Mexico, Colombia and Brazil.

While some oil companies are trimming their investments, many are too far along on projects to turn back, said Jay Hakes, chief of the department's Energy Information Administration, which issued the report. "You can't just turn the spigot off on a well that's already producing," he said.

The 13-cent-a-gallon savings in the year 2000 are from the prices forecast if there had been no Asian crisis. Analysts at the Energy Department and the oil companies doubt that oil prices will necessarily remain at the present levels of less than $13 a barrel. The partial resumption of Iraqi output, to pay for food, has recently forced prices down, leaving unleaded regular gasoline at less than $1 a gallon throughout much of the nation.

The Energy Department, relying on economic forecasts by DRI/McGraw Hill, sees Asia recovering so slowly that the average oil price in the year 2000, adjusted for inflation, will still be less than $14 a barrel.

That price is about $5.50 a barrel less than the $19.50 the department predicted last year, before the scale of Asia's problems became evident.

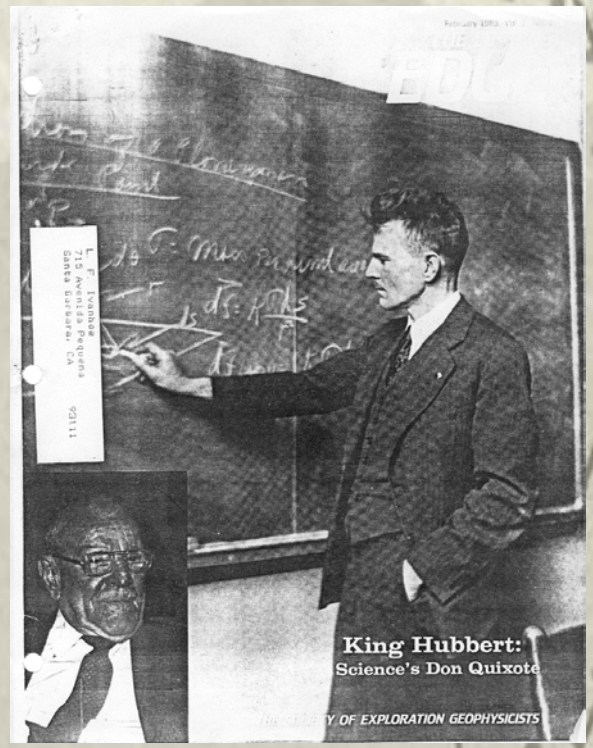
Hakes cautions that it is unclear how quickly Asia will recapture foreign investment. But even if energy demand there soars once again, he says, global production can keep up. Not until about 2007 does his agency see oil prices returning to about where they would have been apart from Asia's woes.

Oil companies, already trying to cut their staffs and economize, have been pessimistic about prices for the next few years.

Mark Moody-Stuart, chairman of Royal Dutch/Shell, the world's largest oil company, recently predicted prices of $12 to $16 a barrel over the next two to three years.

Long-Term Forecasting (Scenarios)

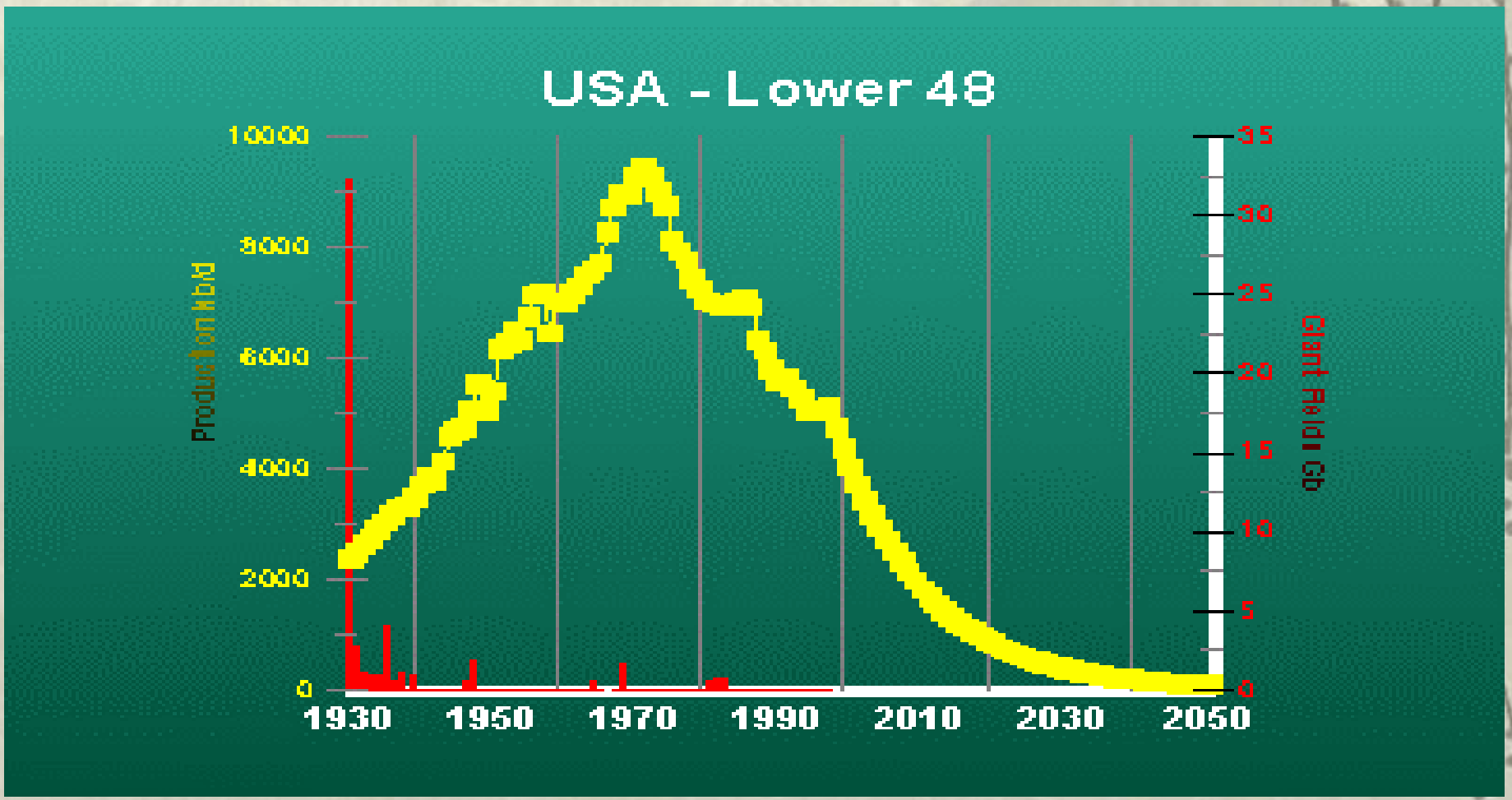
- **How much resource is out there?**
  - **Geology and EUR**
- **What development rate?**
- **What depletion rate?**
- **What rate of demand?**



•Hubbert (USGS) 200 BBl *vs.* McKelvey/Zapp (USGS) 590 BBl

•Hubbert won ***big*** ***(but for 20 years, poor assumptions hurt energy policy)***

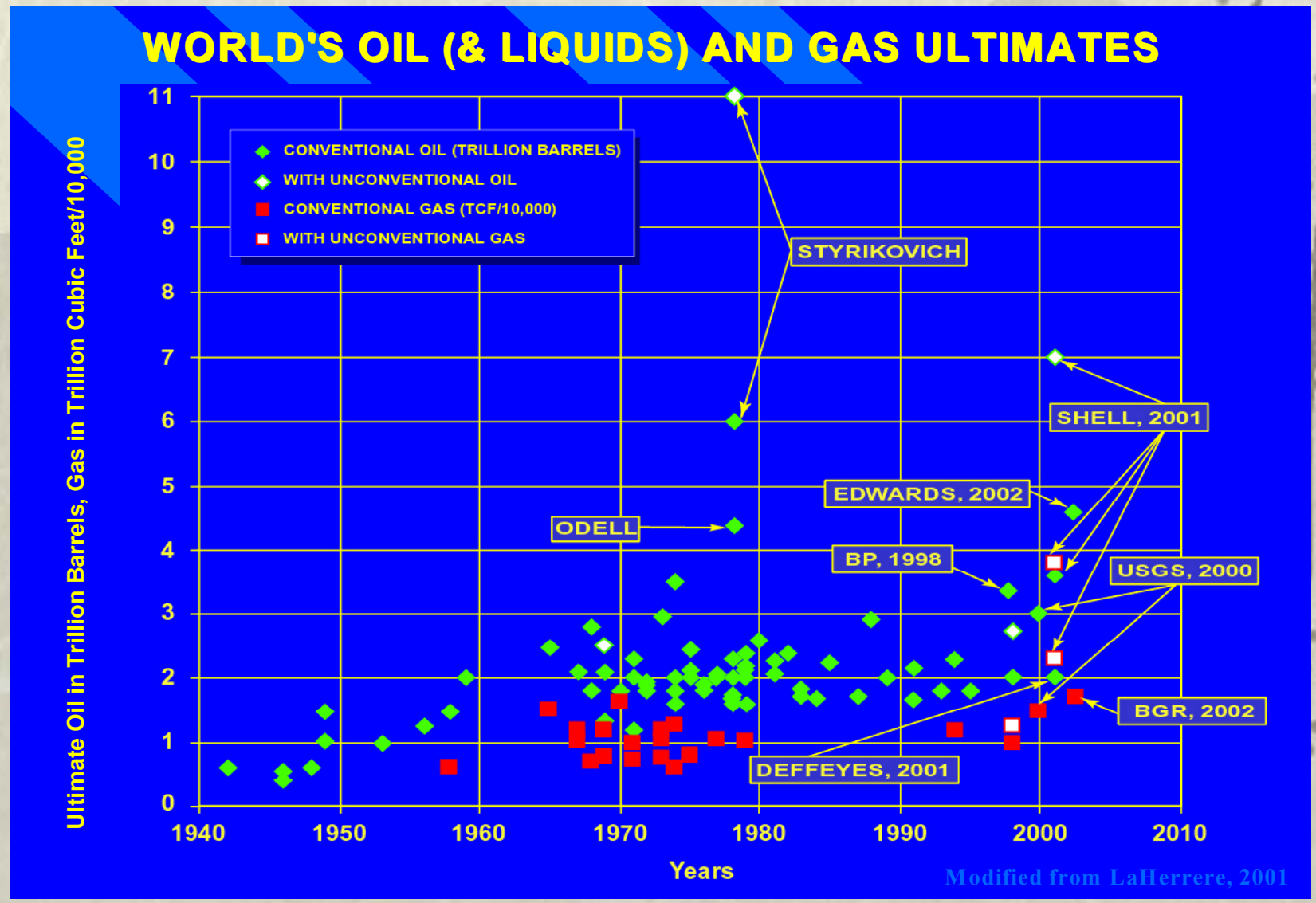
Lower-48 States: history and projected crude oil production

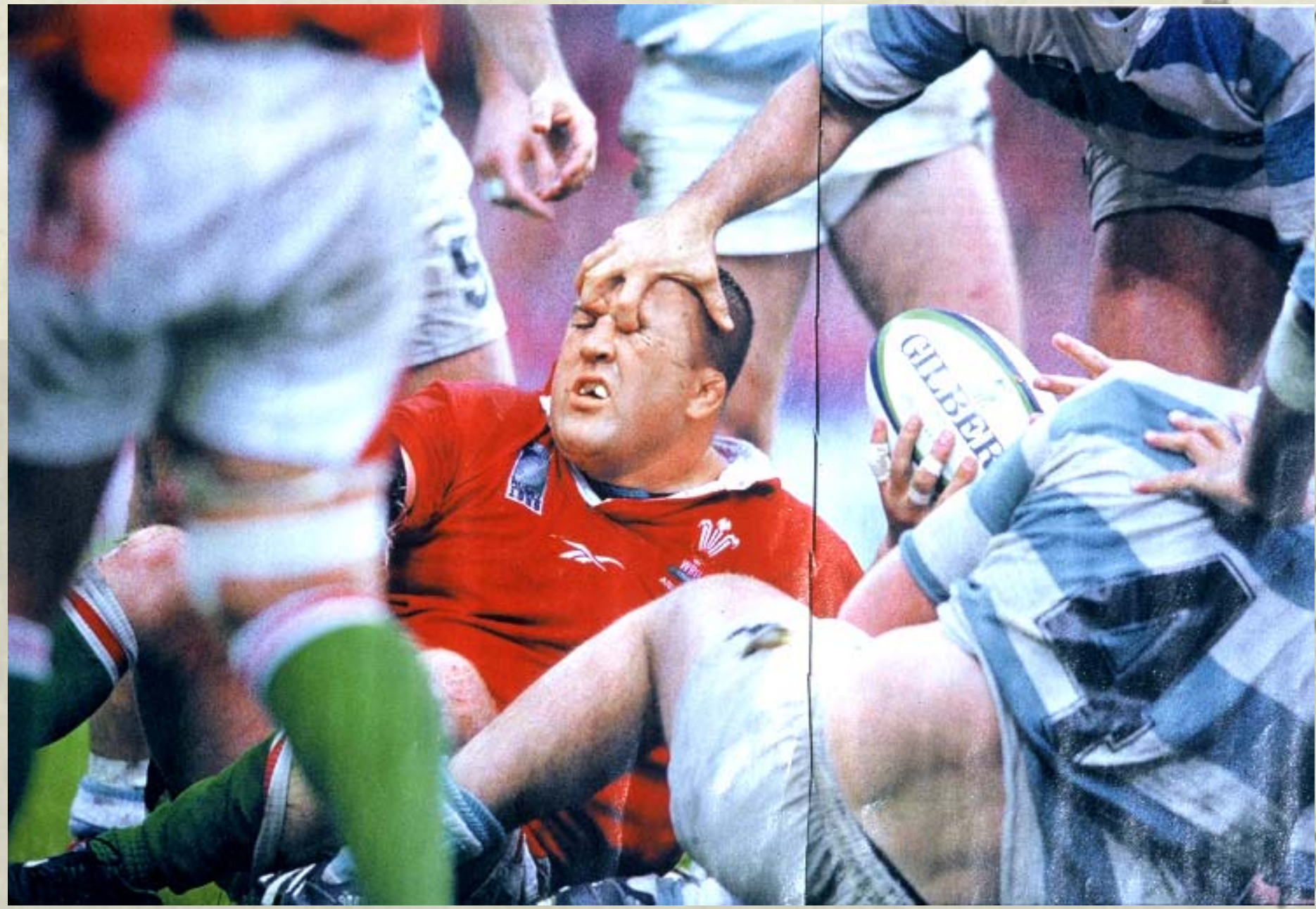


Review of Oil EUR Assessments

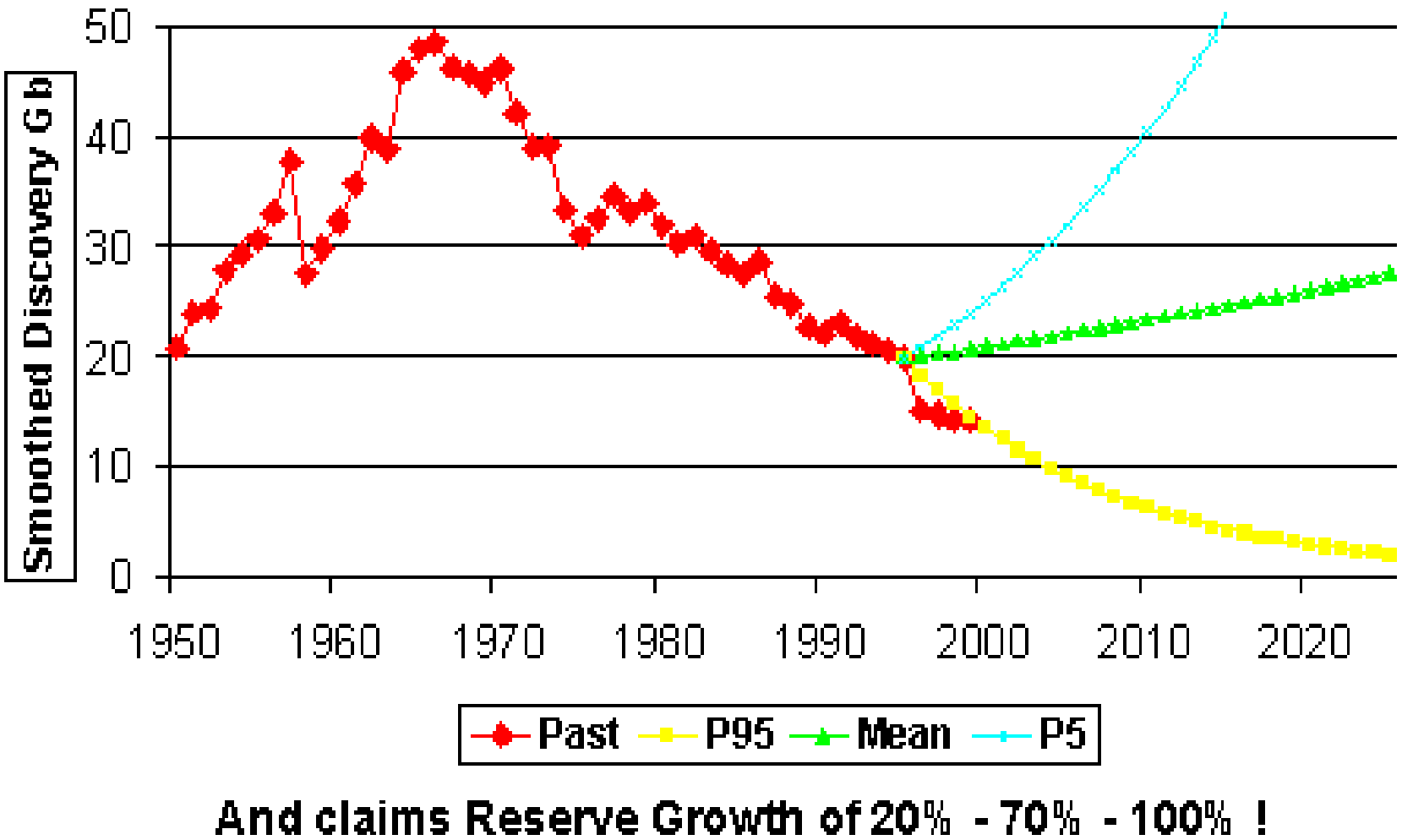
- 1942 to present
- Learning curve
- Trend: multiple analyses/forecasts by same individuals leads to higher assessments
- One grouping around 2 trillion barrels conventional oil
- Some recent #s towards 3 trillion—especially "all liquids" numbers…

EUR listing from the USGS




GILBER

Which USGS estimate ?

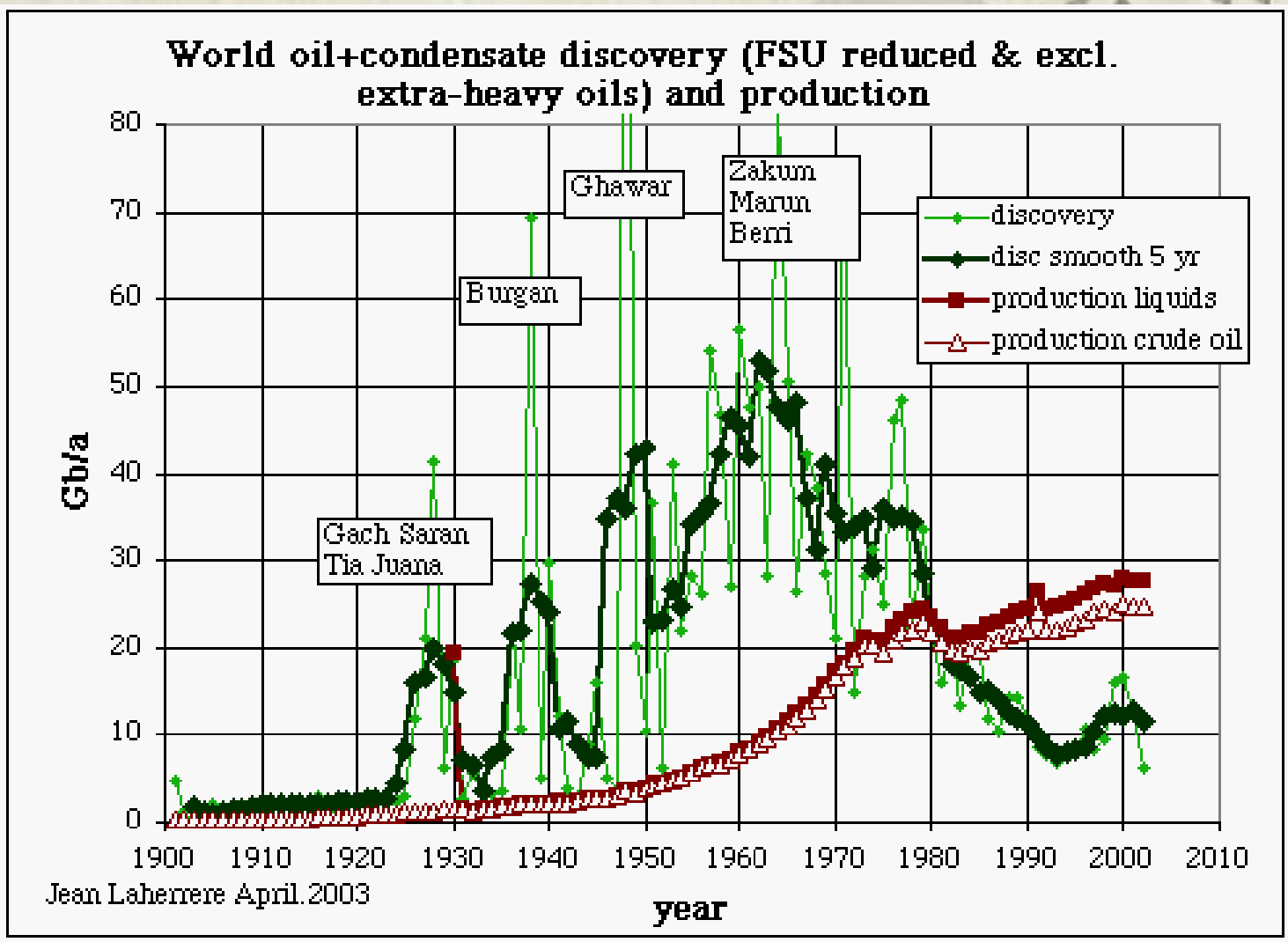


And claims Reserve Growth of 20% - 70% - 100% !

Source: Colin Campbell, author and retired petroleum geologist (ASPO)

Discoveries peaked during 1960s; lagging the USGS projection

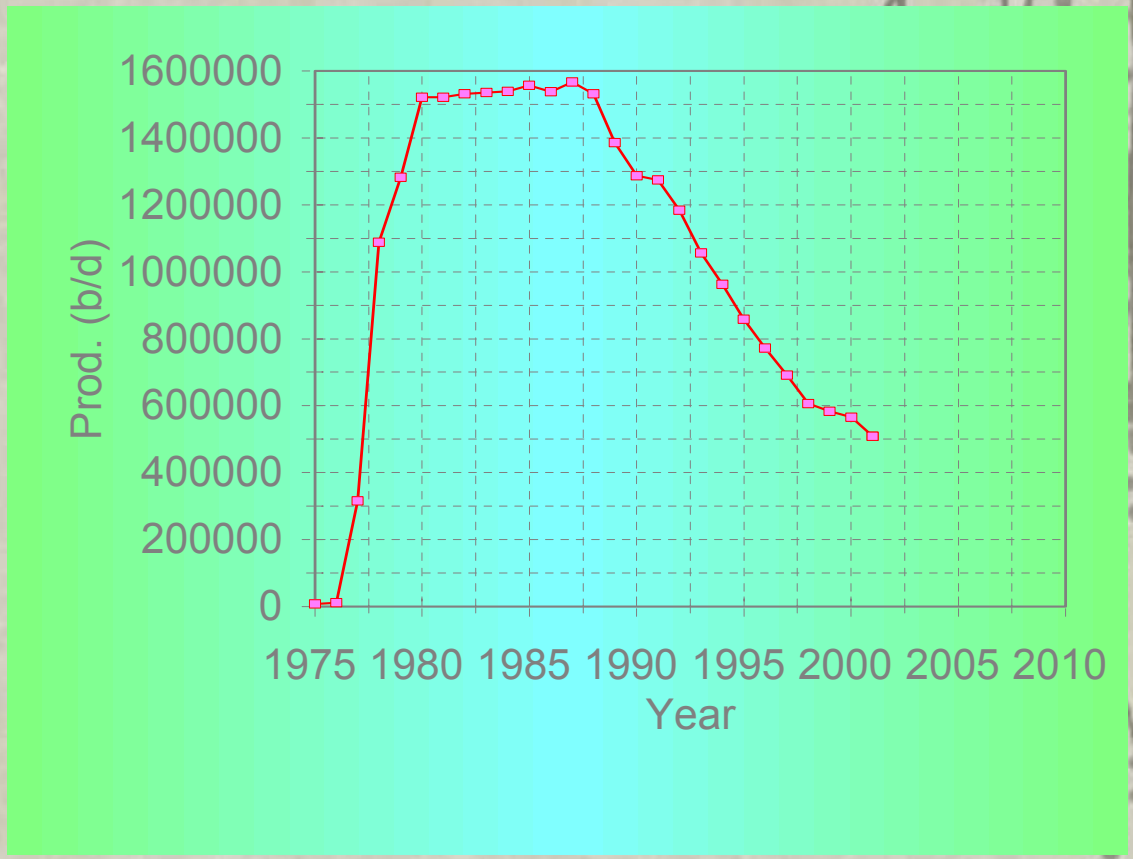
- 1980s OPEC increases due to "quota wars" not based on *discoveries*



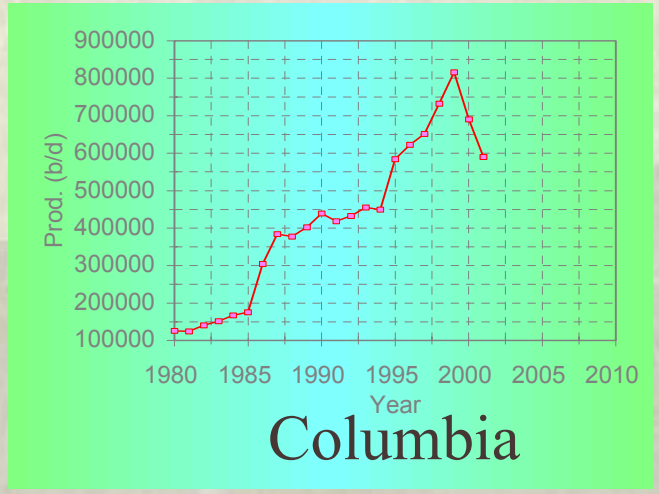
Matt Simmons' studies of giant oil fields:

Helping us understand depletion…

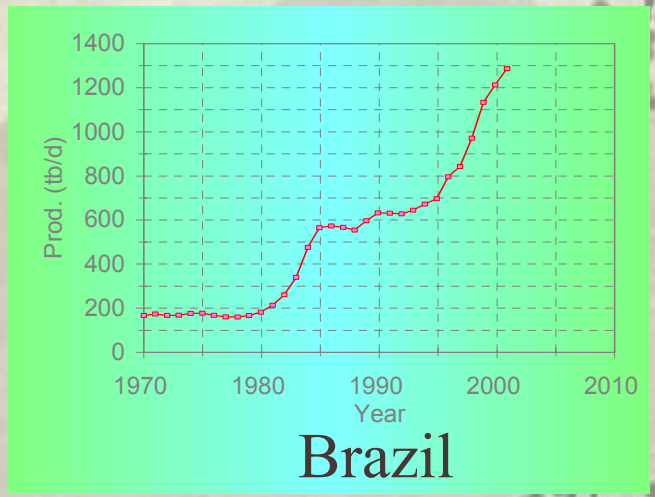
- **Prudhoe Bay: largest oil field in the US**
- **Well-managed oil fields are like athletes**
- **Production peaked in 1987**
- **Depletion: over a 2/3 production decline**



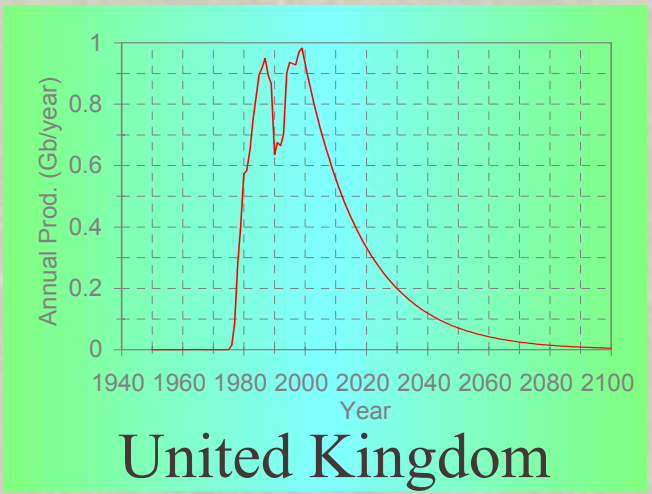
Historic depletion (and projected) production in selected countries



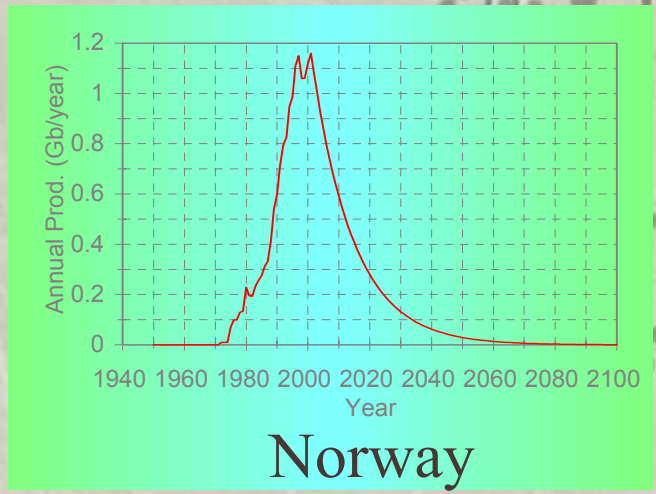
Columbia



Brazil

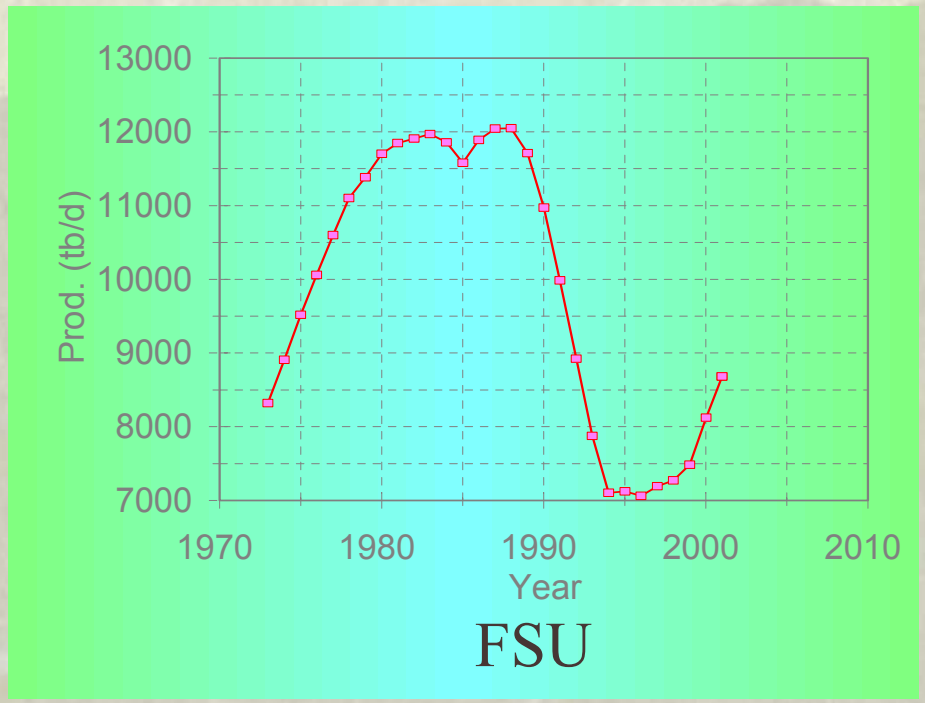


United Kingdom

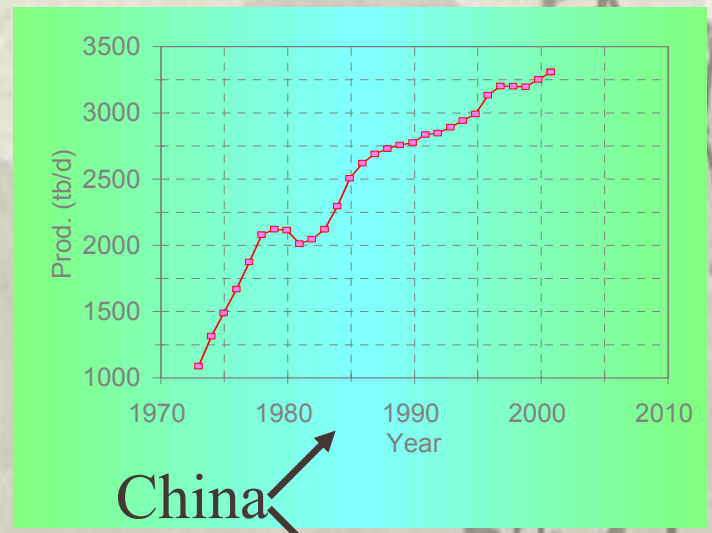


Norway

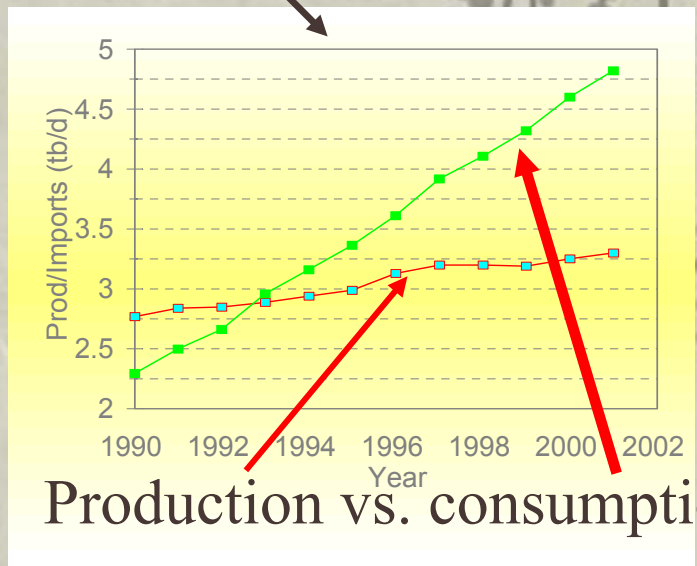
The non-OPEC "Critical Two"



FSU



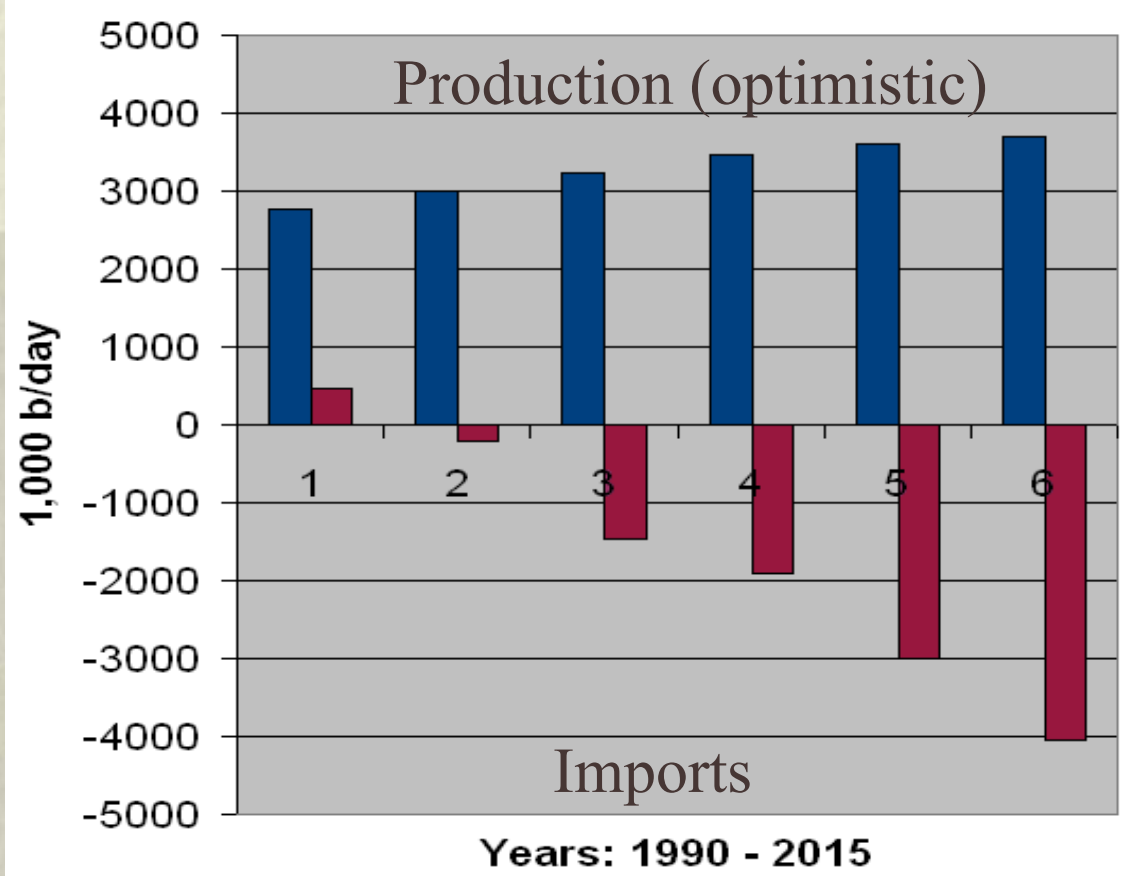
China



Production vs. consumption

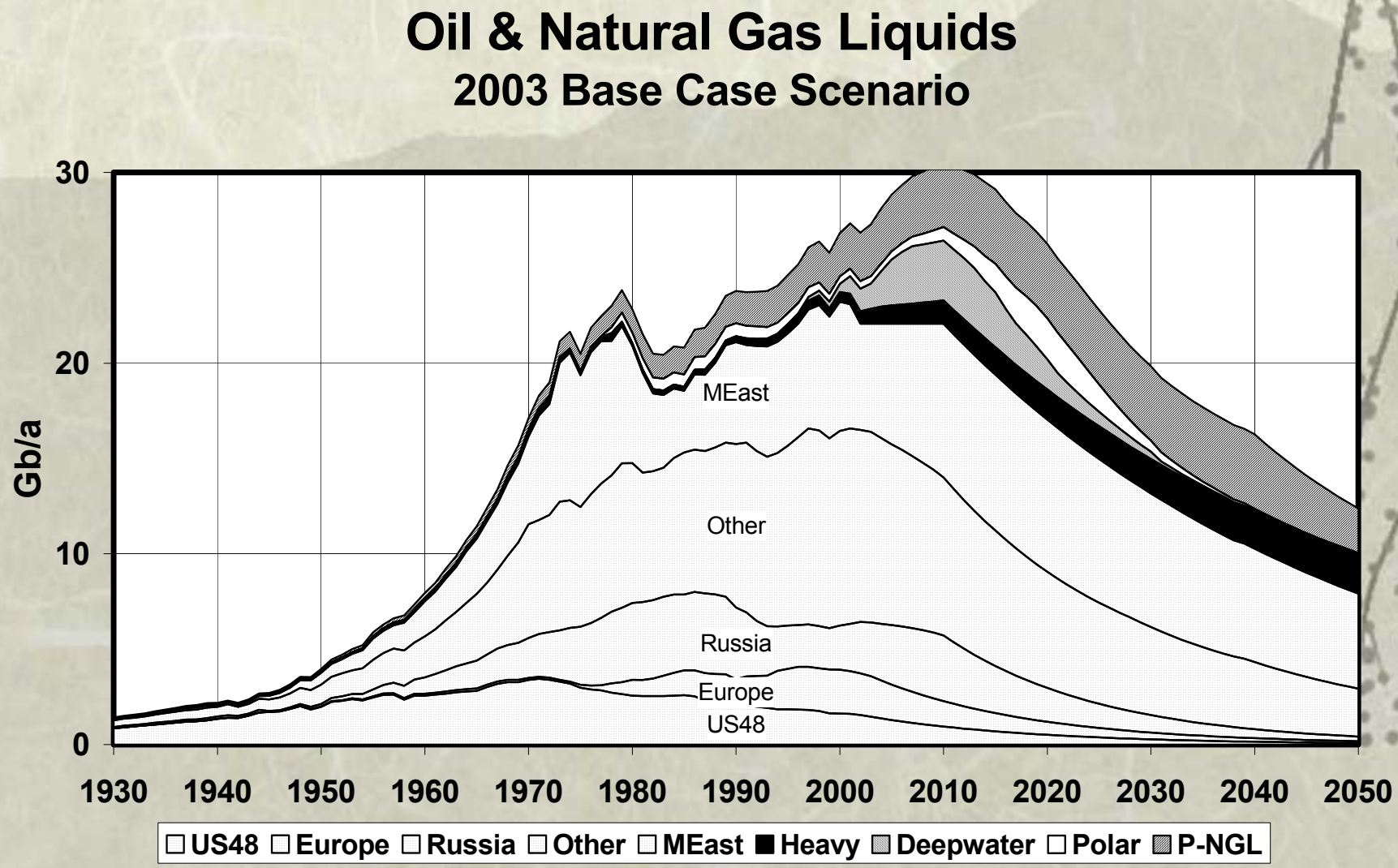
The China Factor

- **Production flat +/- (Daqing field)**
- **Imports increasing 30% this year, up to 4 million b/d by 2010—60% of use**
- **Energy market problems today**



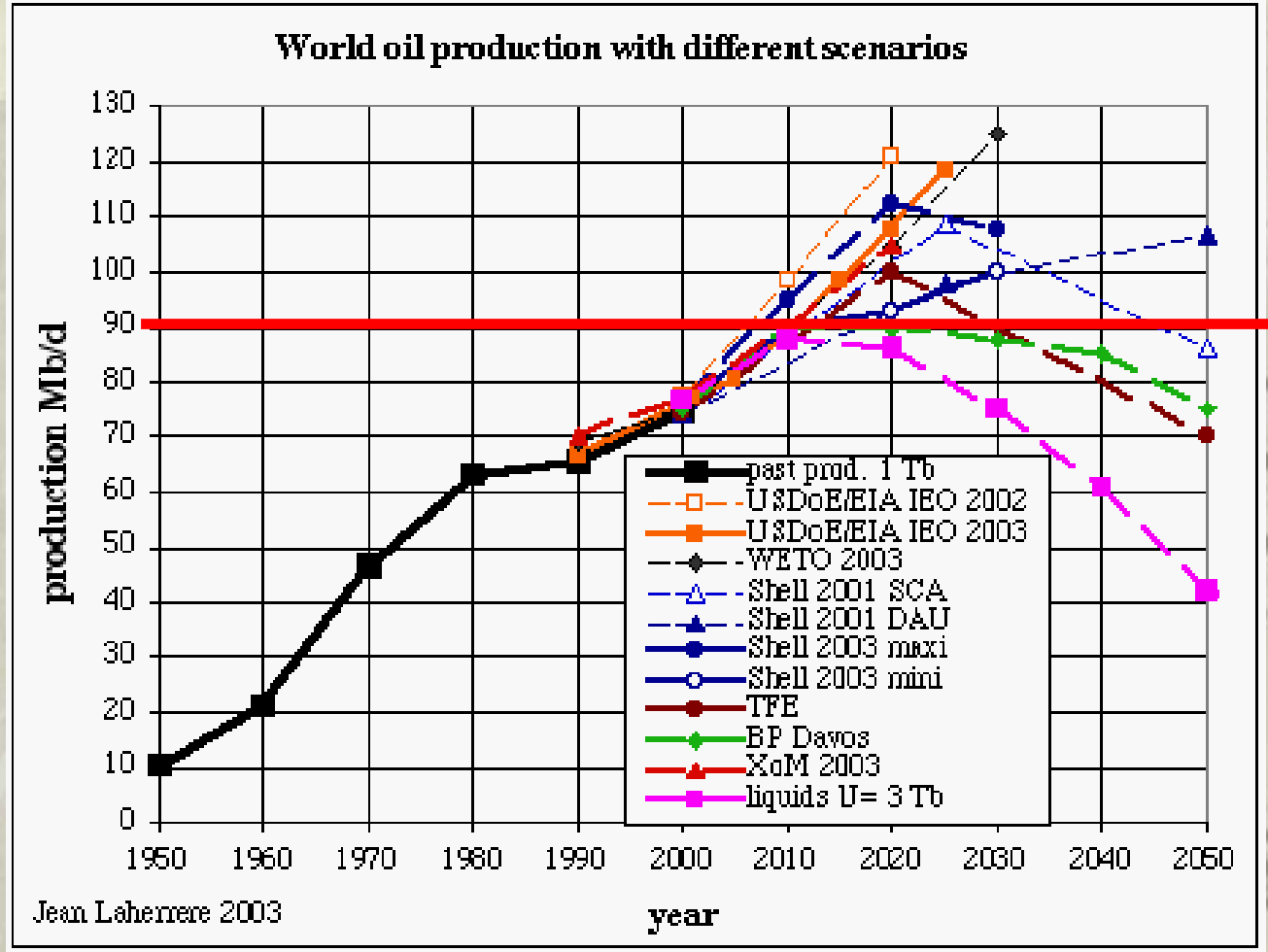
- ***WSJ 12/3/03: BP's chief economist Peter Davies—"The whole center of gravity of world energy markets is changing."***

From EUR to World Oil Peak: The Forecast According to ASPO

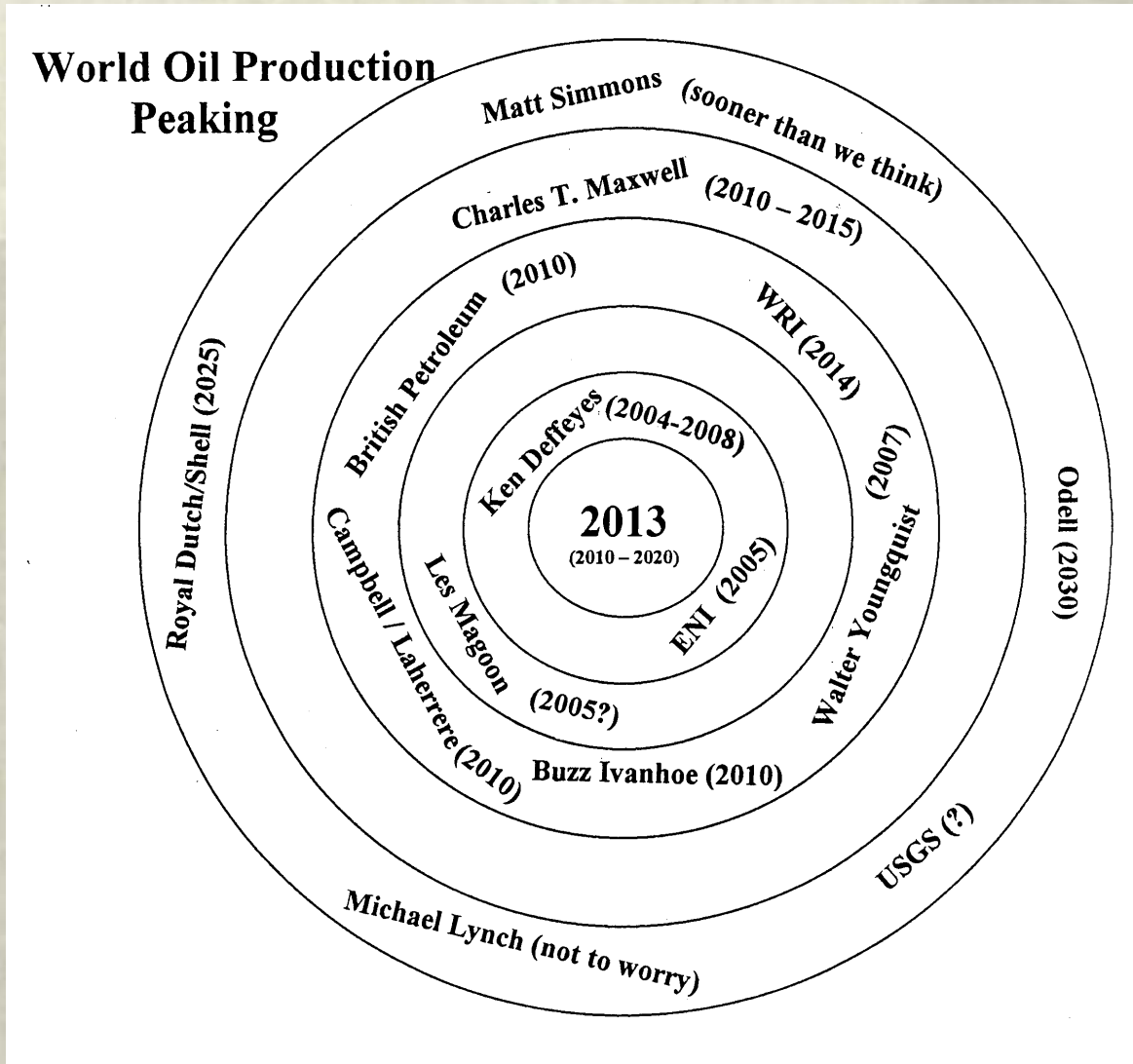


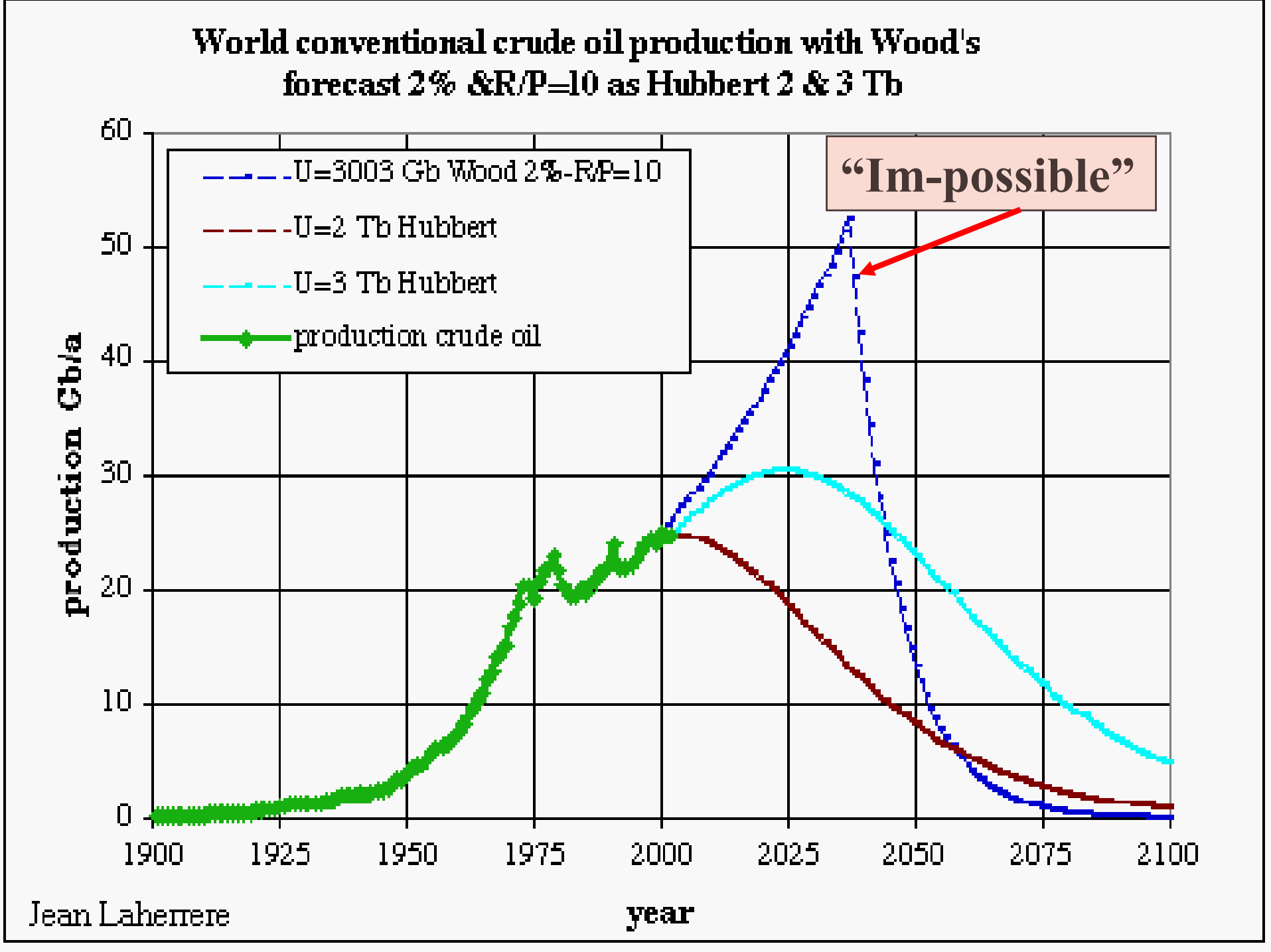
Remember: forecasting a peak *doesn't* mean "*running out*"

Problem: many commentators don't see the world reaching above 90 million barrels/day, due to a variety of issues (geology, investment, infrastructure, the economy, etc.)



Range is broad by well-informed estimators; most by 2020




World conventional crude oil production with Wood's forecast 2% &R/P=10 as Hubbert 2 & 3 Tb
U=3003 Gb Wood 2%-R/P=10
U=2 Tb Hubbert
U=3 Tb Hubbert
production crude oil
"Im-possible"
production Gb/a
60
50
40
30
20
10
0
1900
1925
1950
1975
2000
2025
2050
2075
2100
year
Jean Laherrere

World Oil and Gas: Large Role of Non-Geologic Factors

Demand side

- Economic health
- Price volatility
- ***Weather roulette***
- Political initiatives
- Political instability
- User/market responses
- Social initiatives
- Surprises (SARS)

Supply side

- Violence
- Market support
- Natural disasters
- Access to prospects
- ***Political unrest/strikes***
- Mergers/labor/rigs
- Elec. supply mandates
- Surprises

The North American (no OPEC) Natural Gas Ambush

- **Why didn't we see this coming?**

1. **Lack balanced vision (highlight new supply)**
2. ***Not all resources are created equal***
   - **Smaller and/or deeper pools require hard-to-imagine drilling rates**
3. **Lack of appreciation of the *depletion factor***
4. **We're increasingly at the mercy of weather roulette**
5. **Bad data generation and forecasting by most players didn't provide warning:**
   - **the NPC 1999 (re # of power plants)**
   - **the GTI**
   - **most industry analysts**
   - **esp. the US EIA**

1-2. Kidding ourselves…

‘Iran taps ‘Persian Gulf’ of natural gas’ in V

Federal energy council will meet in Colorado

By Mike Soraghan
Denver Post Washington Bureau

WASHINGTON — The Bush administration has singled out the Rocky Mountain West for a pilot project to speed up energy development.

The White House has charged a group of top administration officials with finding ways to streamline environmental approvals and accelerate renewable-energy projects, pipeline construction and natural-gas drilling on public lands.

The group, called the Rocky Mountain Energy Council, is to hold its first meeting Tuesday at the Denver Federal Center, where it may set up permanent offices.

The Bush administration and industry are eager to tap into what's been called a "Persian Gulf of natu-

ral gas" in the West, an ing comes after dire warn Federal Reserve Chairm Greenspan of natural-gas sh damaging the U.S. economy. The council's goal is to get t al and state officials talking prevent unnecessary production jays in Colorado, Montana, Ne Mexico, Utah and Wyoming. "The Rocky Mountains are 'ener- gy central' in the West," said Jim Sims, who worked for Vice Presi- dent Dick Cheney in developing the National Energy Plan and now runs the Golden-based Western Business Roundtable, an associa- tion of energy companies. "From a business perspective, we would rather have a fast 'no' than a slow 'maybe.'"

Ideas the council may consider include working on several environ- mental permits at once rather than reviewing them in sequence, and highlighting problems early in the process.

SEE COUNCIL ON 15A

D Post

8/6/03

2. Regional Resource Assessment Summary

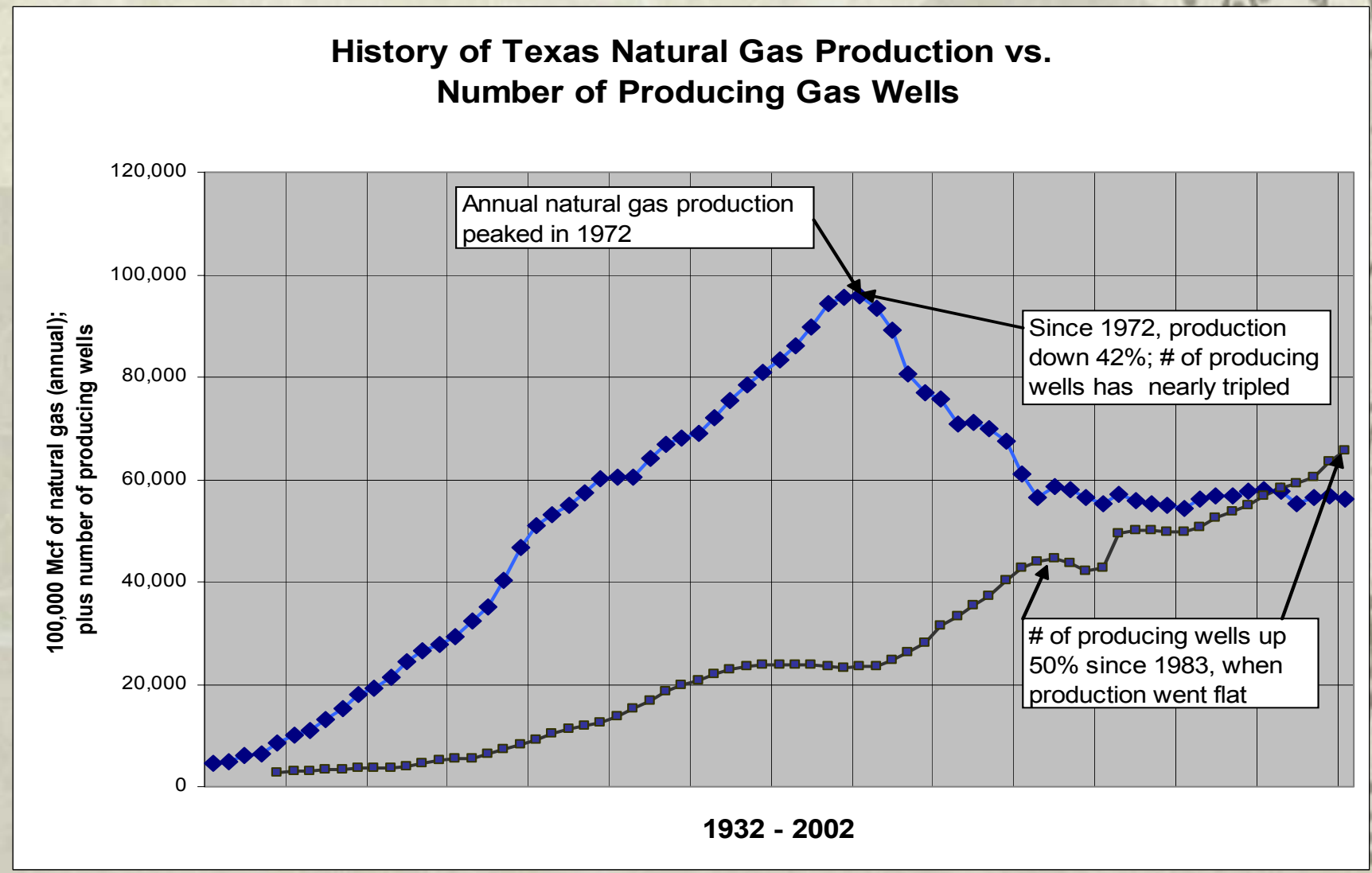
PGC Area	Traditional Resources (Mean, Tcf)	Coalbed Gas Resources (M.L., Tcf)	Total Resources (Tcf)	Region's Proportion of Total L48
Gulf Coast	292.8	3.4	296.2	34.0%
Rocky Mountain	175.1	63.3	238.4	27.3%
Mid-Continent	116.9	10.3	127.2	14.6%
Atlantic	103.9	17.3	121.2	13.9%
Pacific	52.5	2.0	54.5	6.2%
North Central	22.0	10.0	32.1	3.7%
Total Lower 48	**765.6**	**106.3**	**871.9**	
Alaska	193.8	57.0	250.8	
Total U.S. (means)	**958.3***	**168.9**	**1,127.1**	

Data source: Potential Gas Committee (2003)

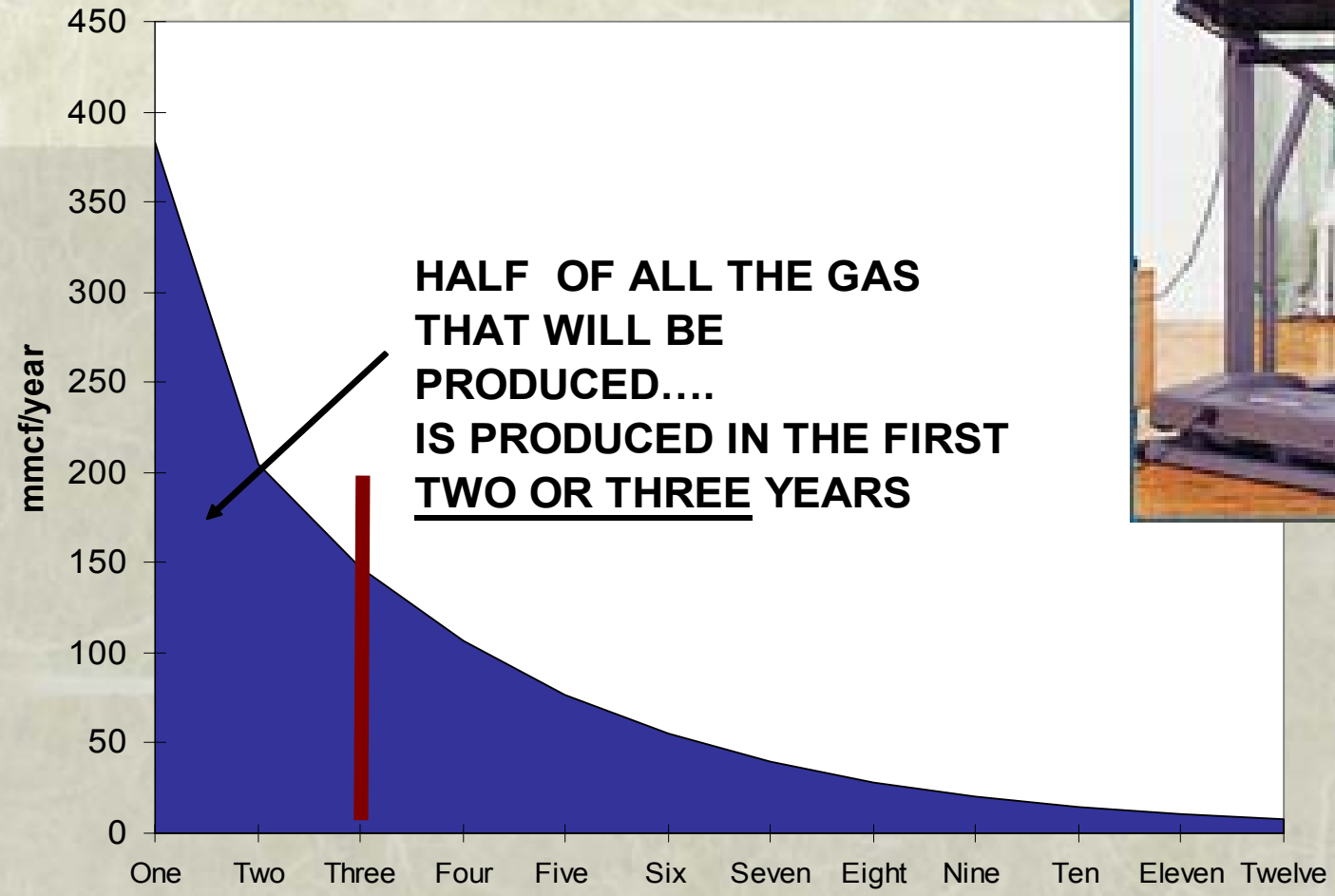
170 Tcf reserves; 1000 Tcf produced to date…

3. Natural gas depletion example

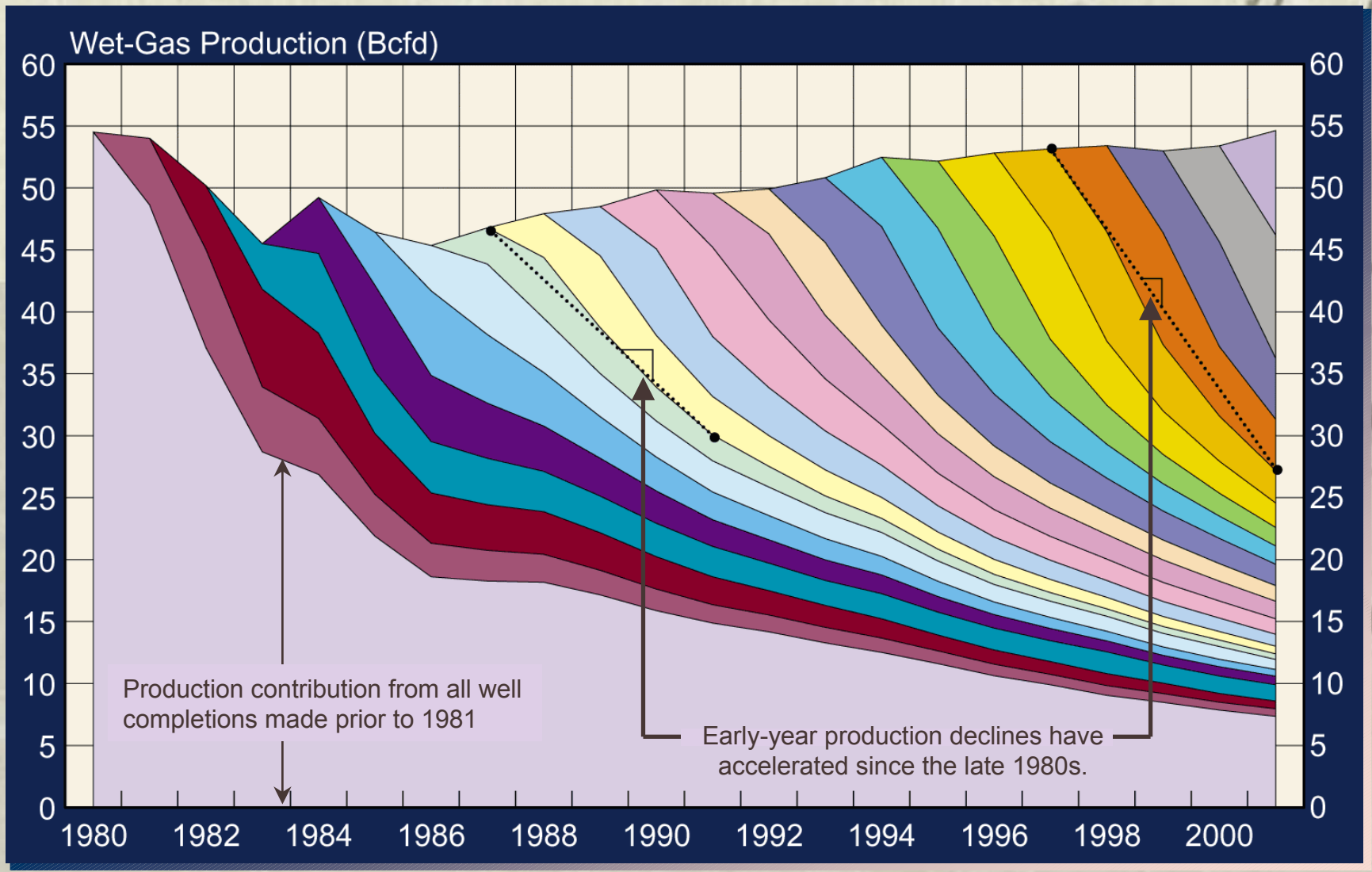
(Texas soon to build pipeline for oil imports)



Depletion treadmill at work: Typical new Texas gas well



Gas Production Replacement, L48 US

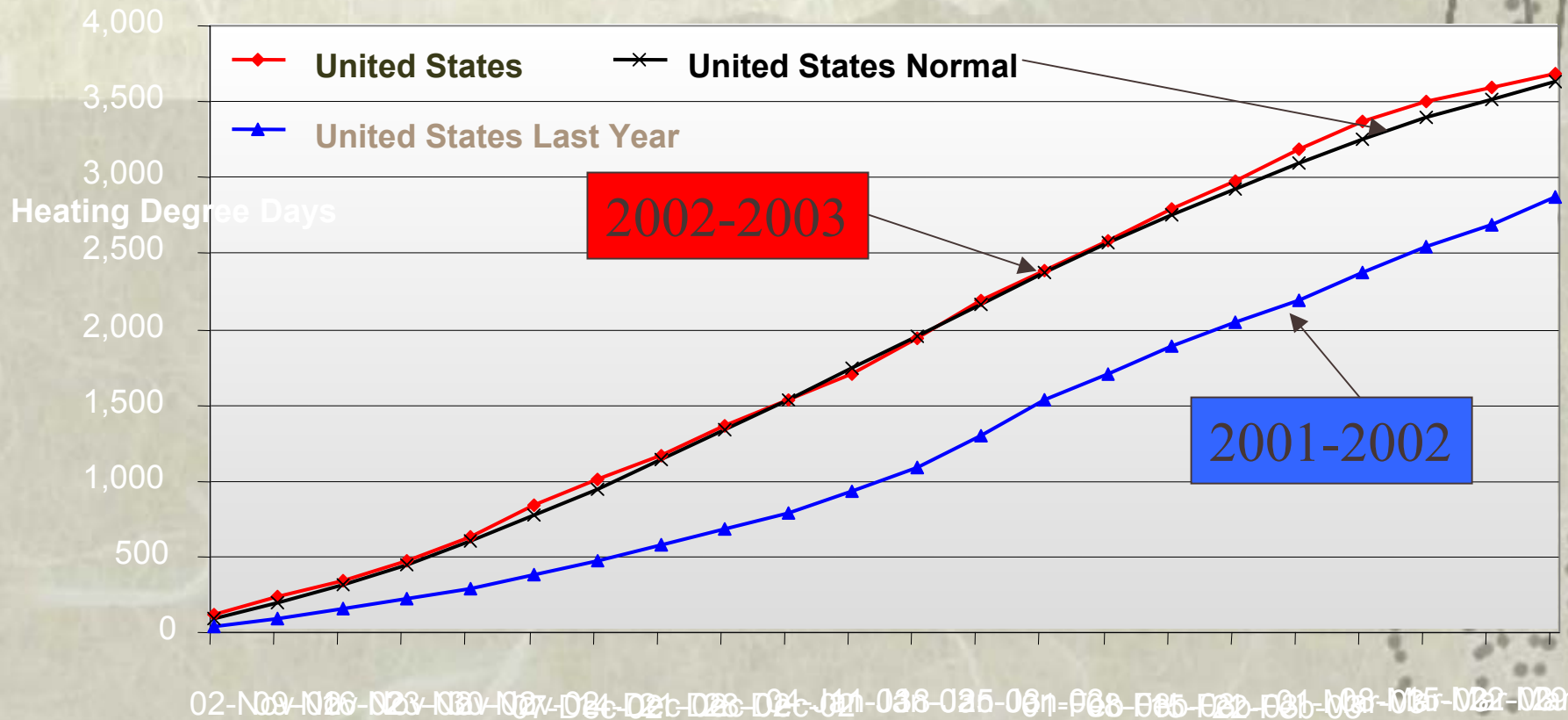


Source: Potential Gas Committee (2003). Data from EIA and Petroleum Information/Dwights LLC (©2002).

4. Weather Roulette:

Winter 02/03 Was Colder Than Winter 01/02 And Colder than Normal in Some Regions

(Cumulative Heating Degree Days, Heating Season 2002-2003)



Source: Derived from Heating Degree Day Monitoring, National Climatic Center.

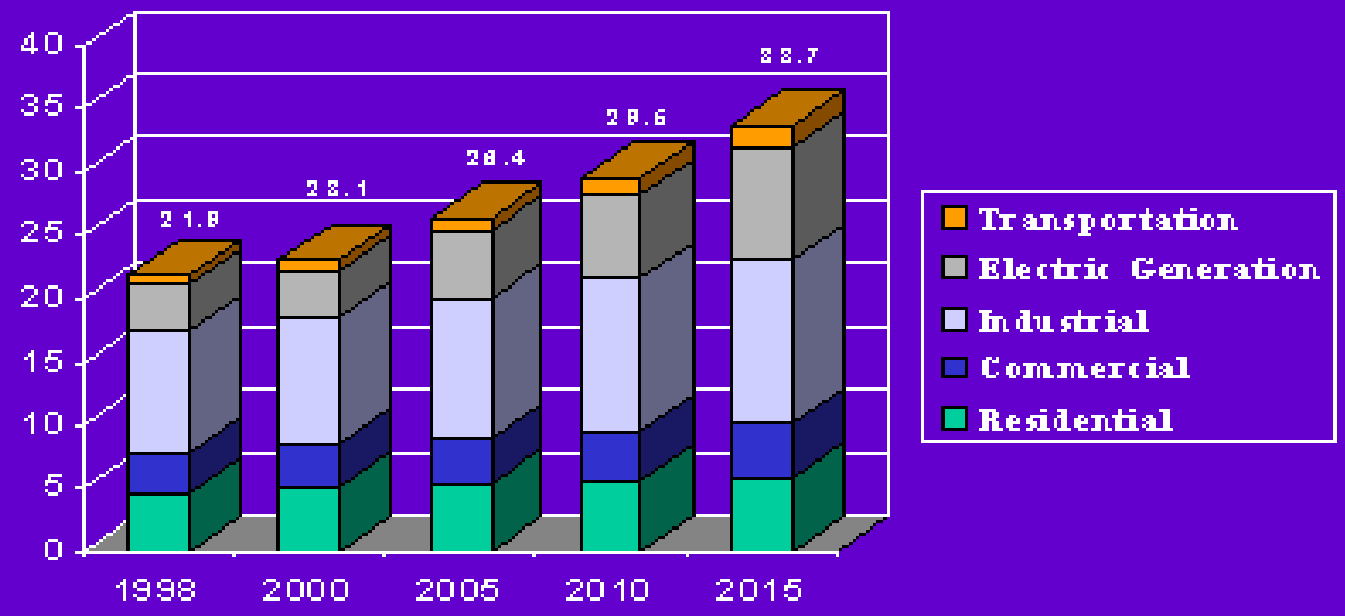
5. *An Industry View of Your Gas Future*

(three slides from GTI's John Kelly, Director of Distributed Energy,11/03)

- "The US hold nearly 100 years of natural gas supplies assuming that prices support this exploration." *[no Thelma + Louis Curve…]*
- "Wellhead prices of $4 would support investment to tap these resources.
- "Continued replacement of older inefficient central gas generation will moderate gas use for power.
- "LNG will play a more significant role in the future moderating prices to around $4

Forecast from GRI in 2000

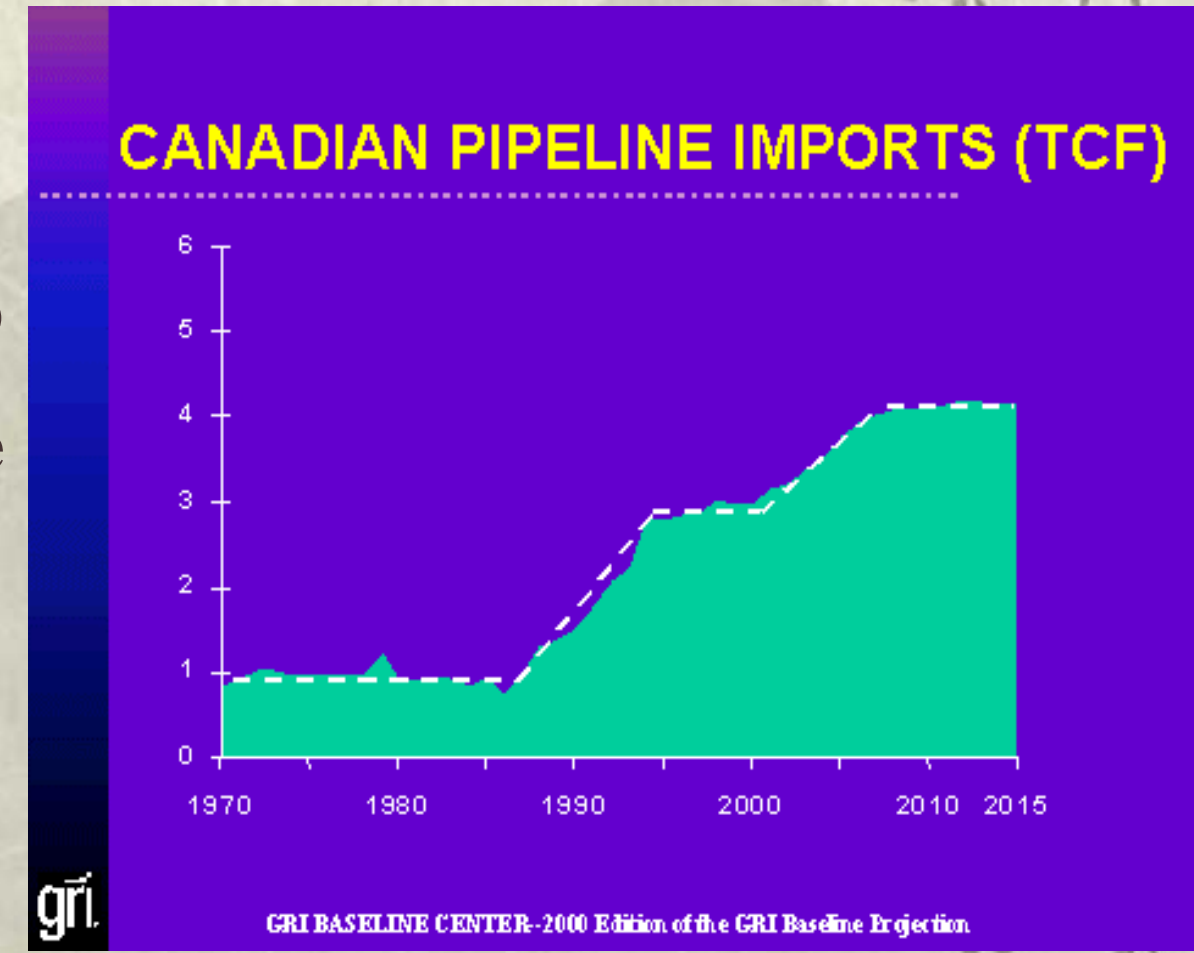
GAS DEMAND BY SECTOR (QUADS)



GRI BASELINE CENTER-2000 Edition of the GRI Baseline Projection

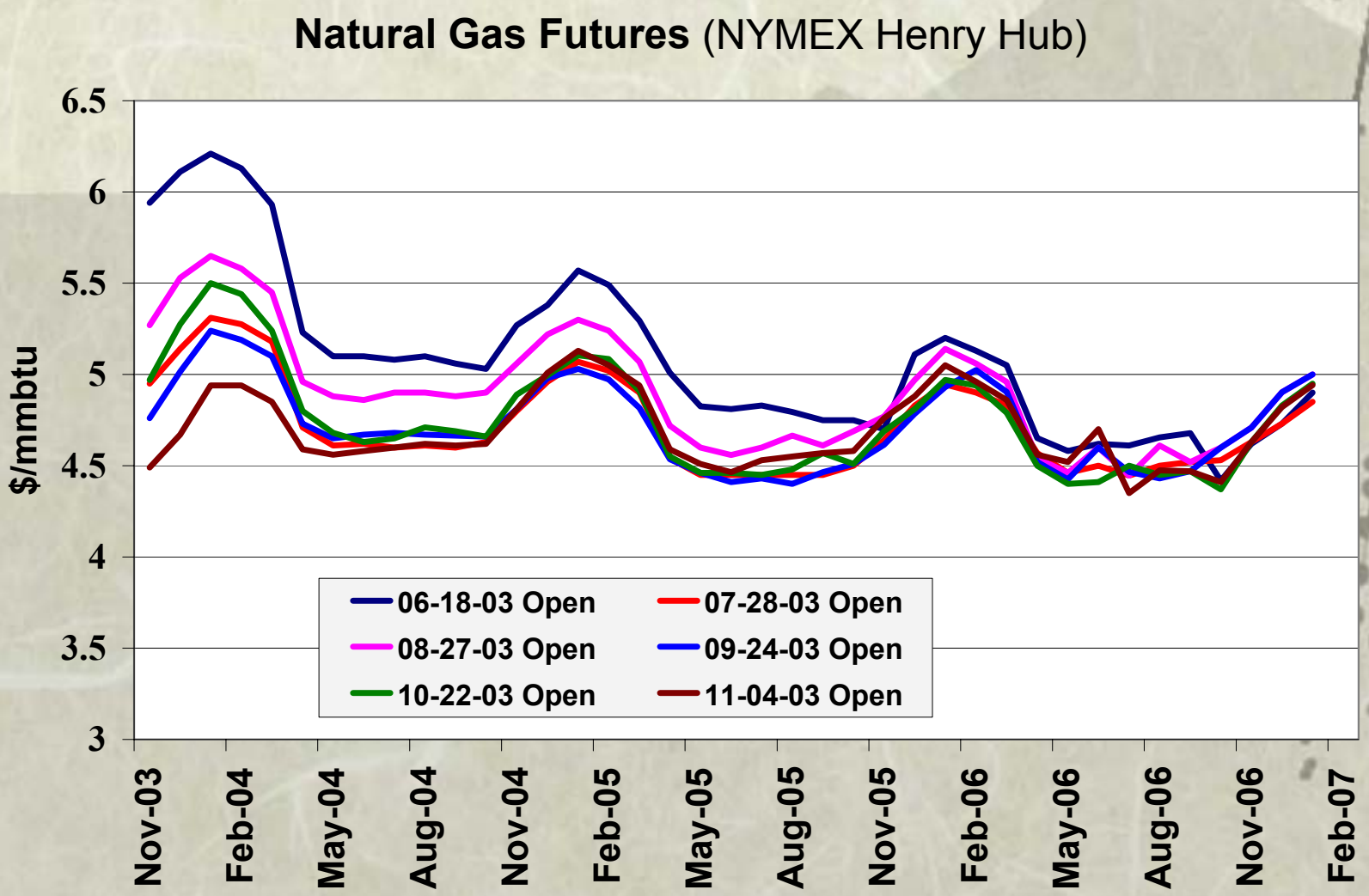
Canadian exports to increase???

- **Production down**
- **Tar sands usage up**
- **Delta pipeline to be high-jacked?**



Future

In early November, GTI asserts futures are "over-valued" (too high)



Natural Gas Prices Giving Bayer a Big Headache

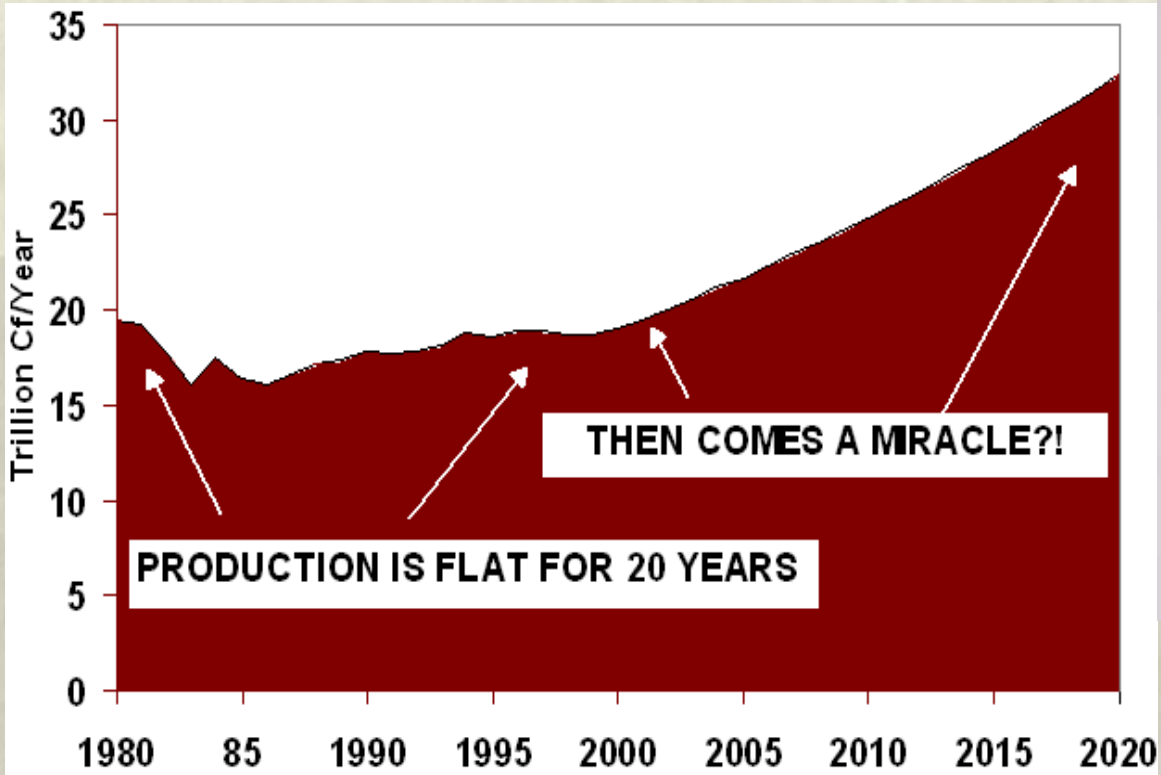
PITTSBURGH, PENNSYLVANIA, May 1, 2003 Bayer Corporation is urging the U.S. Congress and the Administration to lift restrictions on natural gas production in the Gulf of Mexico and the Outer Continental shelf and encourage natural gas supplies from Canada. Unprecedented leaps in natural gas prices ushered in by diminishing supplies and rising demand threaten the U.S. chemical industry and economy, Bayer maintains.

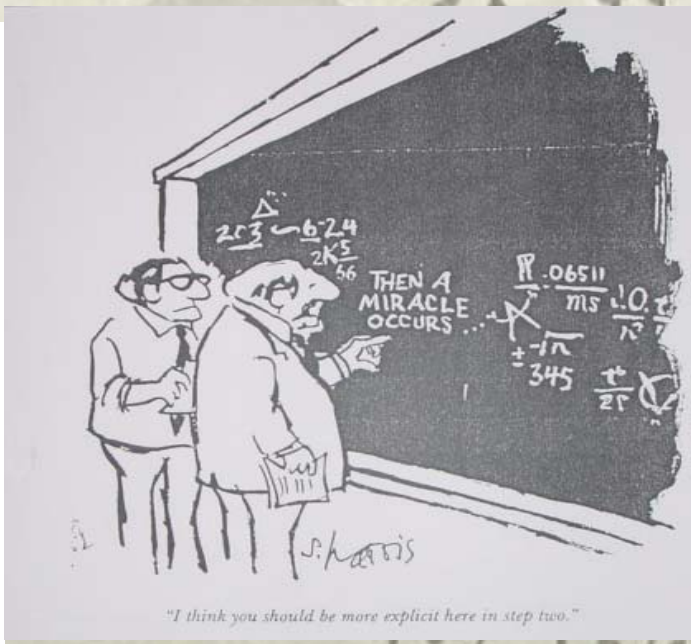
"The U.S. chemical industry uses 11 percent of all natural gas in the U.S. as feedstock material and to run its plants," explained Attila Molnar, Bayer Corporation President and Chief Executive Officer.

"Natural gas prices should presently be between $2.50 and $3.50 per million cubic feet to keep the U.S. chemical industry competitive in worldwide markets," Molnar said.

EIA'S Immaculate Deception?

2000, then 2003 US natural gas: past and future…





- US Production up 37% by 2025
- Canadian imports up 57%

•Prices: $3.25 in 2007, $3.95 in 2025 (2001 $)

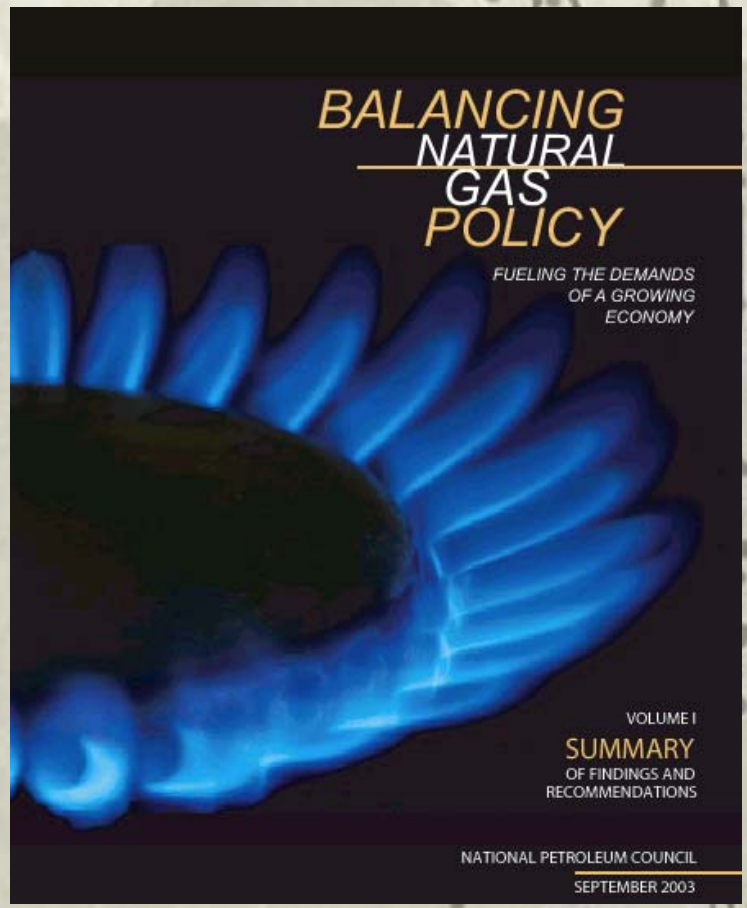
Conventional wisdom: Build pipelines to bring proven gas down from Alaska and the Mackenzie Delta

The reality: It will be slow and expensive to build. [Daniel Yergin quote] We're on a steepening treadmill. We can't just drill and pipe our way out of this. Balance….

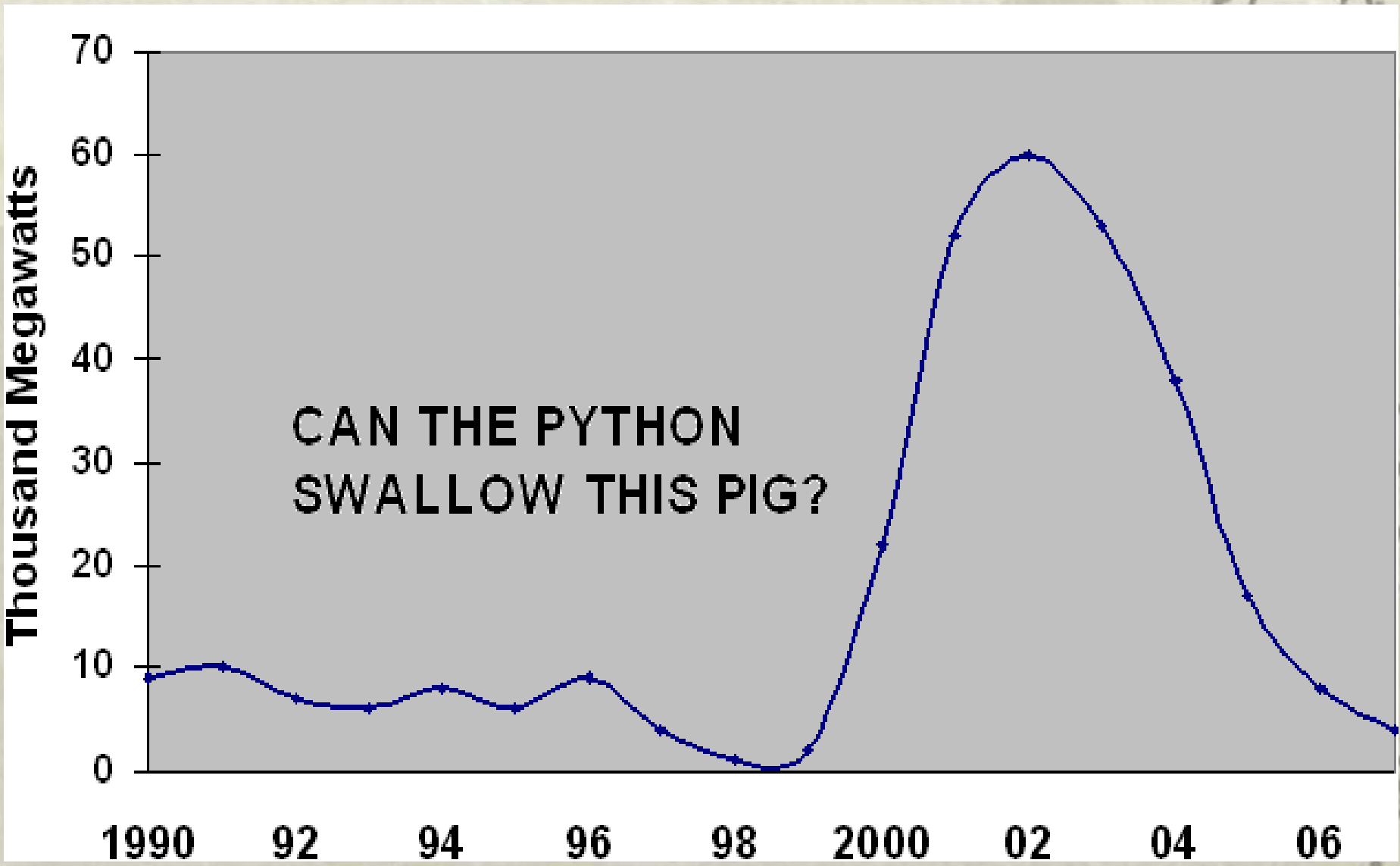
The Harsh Reality (from NPC Report)

"Recent fundamental shifts in North American natural gas markets have led to the current market conditions of higher gas prices and increased price volatility. This situation will likely persist…

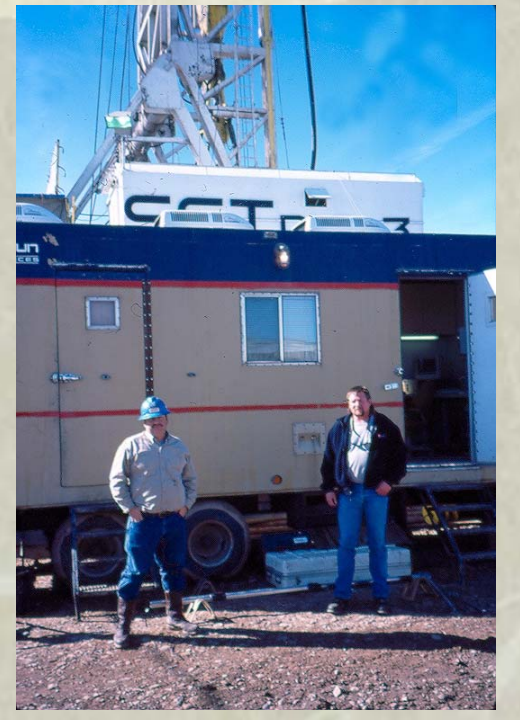
- **"Production from traditional US and Canadian basins has plateaued.**
- **"The 1999 NPC study assumed 144 gigawatts of new capacity through 2015, while the actual new capacity is expected to exceed 200 gigawatts by 2005."**

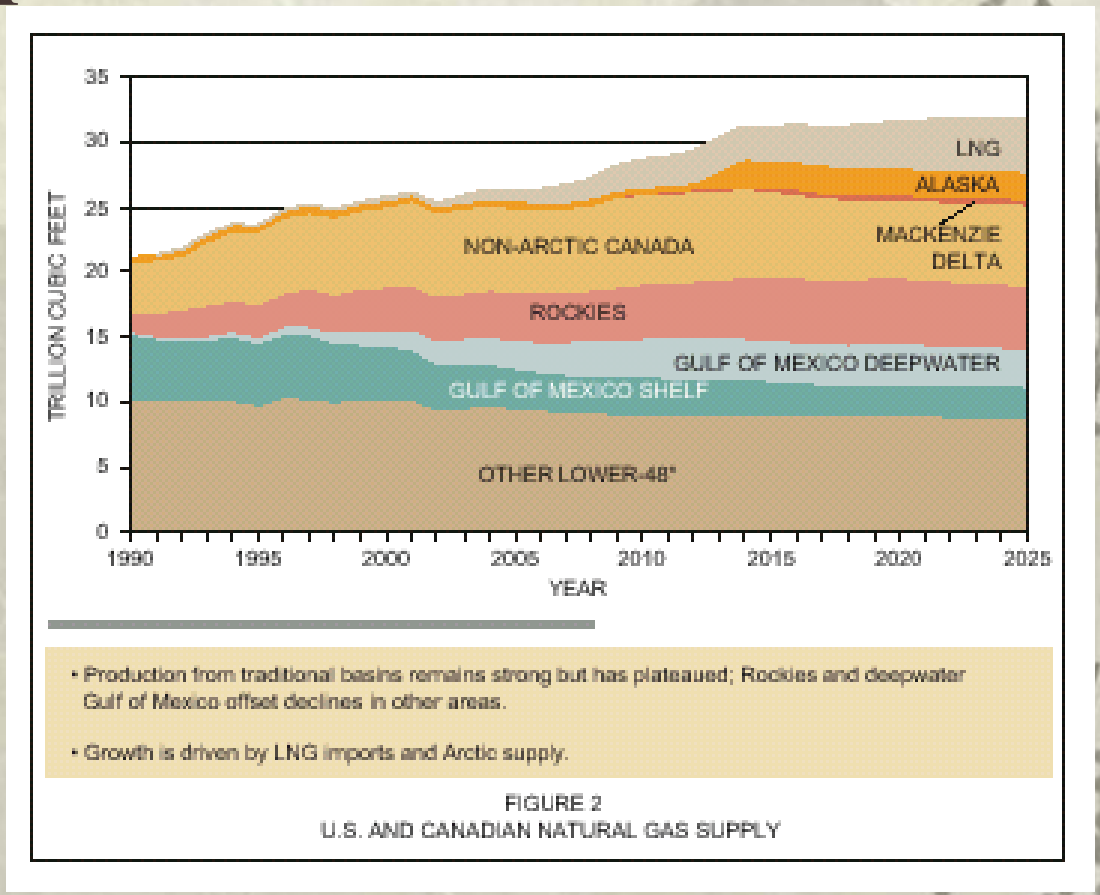


Gas-fired power plant additions



North American production according to the NPC Report to the US DOE (September 2003)





NPC sees 32 Tcf by 2025 for N.Am vs. EIA's 35 Tcf for US alone by 2020

Best case takes lots of commitment

RANGE OF POTENTIAL PRICES

Supply and demand will balance at a higher range of prices than historical levels. That price range will be primarily driven by demand response through efficiency and fuel flexibility, the ability to increase conventional and nonconventional supply from North America including the Arctic, and increasing access to world resources through LNG. National Petroleum Council price ranges for the alternate scenarios are illustrated in Figure 6. These are not status quo scenarios. They both require significant initiative by policy makers and industry stakeholders to implement the recommendations of this report in order to achieve a balanced future.

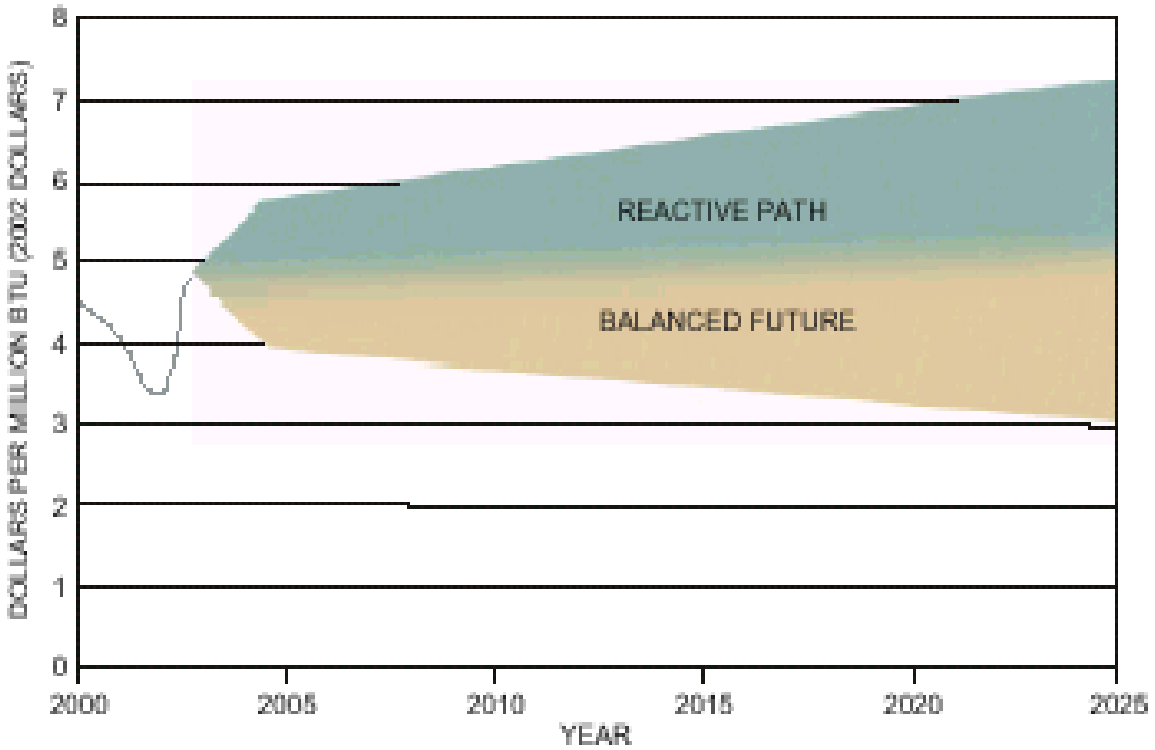


FIGURE 6
AVERAGE ANNUAL HENRY HUB PRICES

North America Natural Gas Peak

- **Optimists: DOE/EIA, GTI**
- **Harsh realists: Alan Greenspan, NPC, Canadian Gas Potential Committee, Simmons & Company International, Walter Youngquist, Richard Nehring, *even the USGS***
- **Geologists: provide estimates of proven, probable & possible reserves**
- **Economists: interpret estimates: prices, technological improvements, econometric models**
- **My guess: will be hard to regain 2001 production**

Deepwater Gulf of Mexico: hope or hype?

- **Large and Giant Fields Are Discovered Early in the Exploration Process**
- **Discoveries of Large Gas Fields in the Gulf of Mexico by Decade**

	Field Size Range			
	>0.5 Tcf	0.25-0.5 Tcf	Total	
1940's	12	3	15	
1950's	15	18	33	
1960's	25	30	55	
1970's	27	41	68	
1980's	10	15	25	(26)
1990's	2	5	7	(20)

Produced by Richard Nehring, NRG Associates

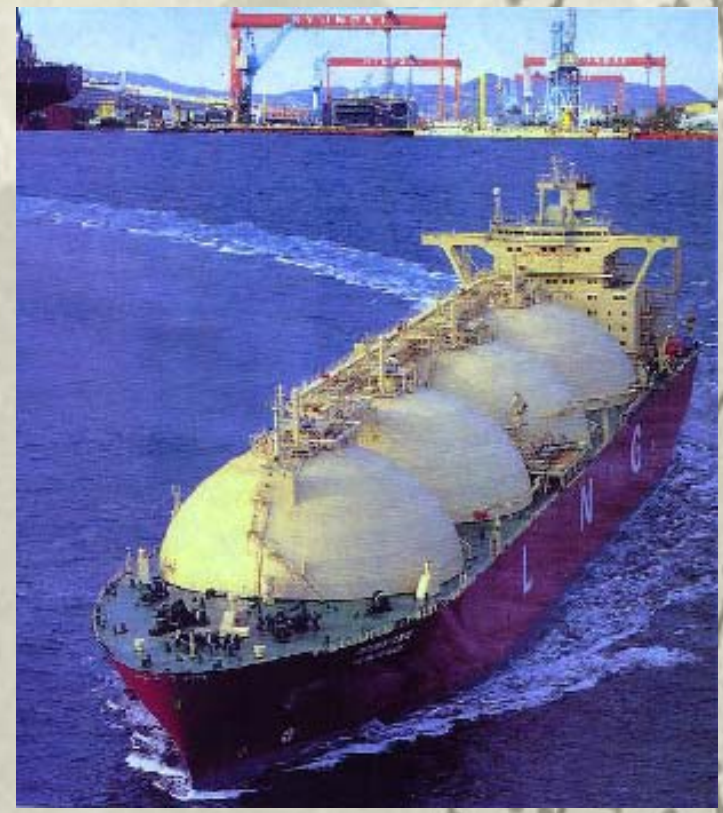
He's concerned

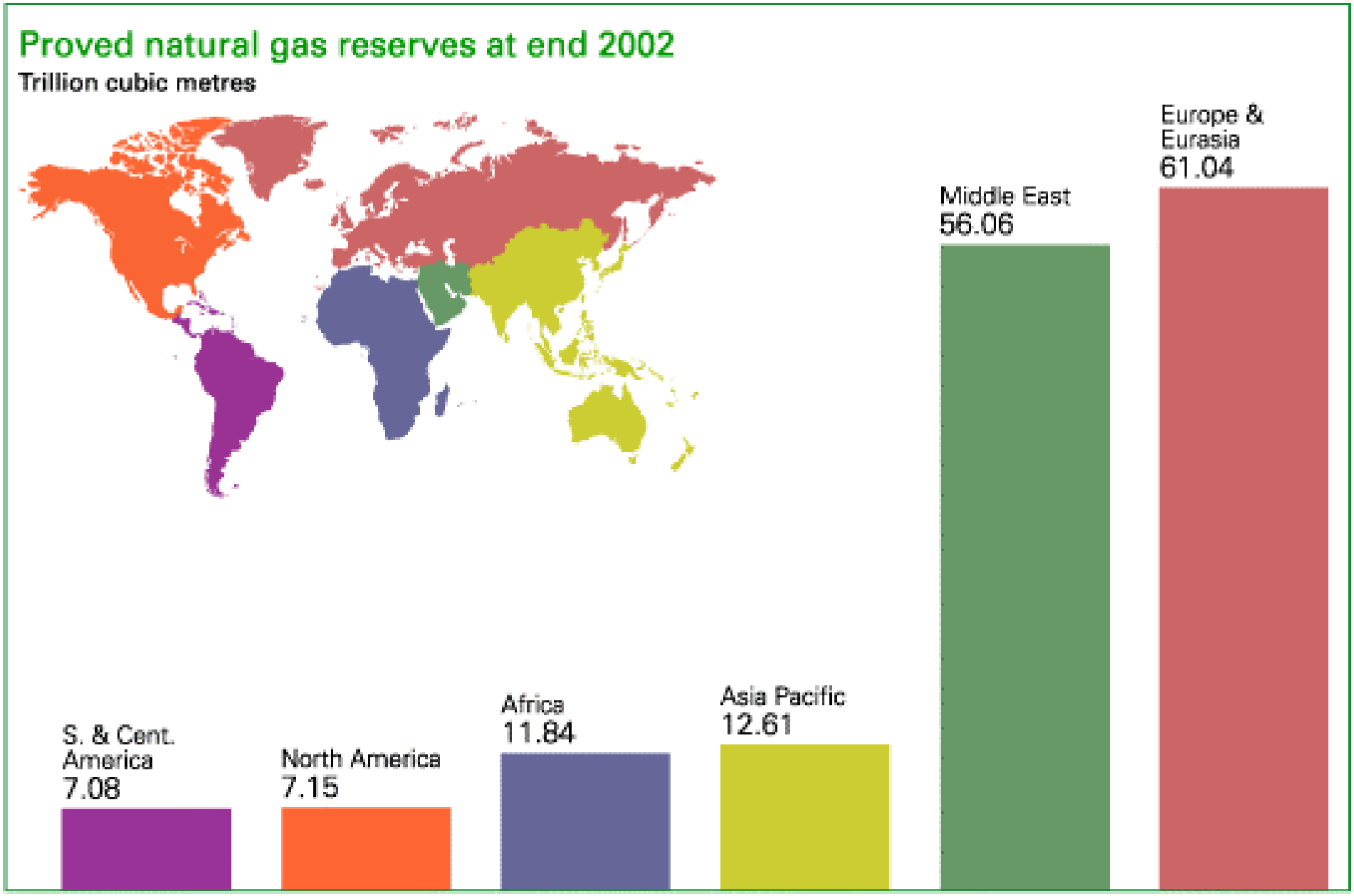
Testimony of Federal Reserve Chairman Alan Greenspan: June 10 (and May 9, and July 10…)

- **"Future prices suggest that we are not apt to return to earlier periods of relative abundance and low prices anytime soon.**
- **"Canada has little capacity to… expand its exports."**
- **Depletion rates 27% today vs. 21% in 1997**

Greenspan on LNG

"Access to world natural gas supplies will require a major expansion of LNG terminal import capacity. Without the flexibility such facilities will impart, imbalances in supply and demand must inevitably engender price volatility. As the technology of LNG liquefaction and shipping has improved, and as safety considerations have lessened, a major expansion of U.S. import capability appears to be under way."





Source: BP Statistical Review of World Energy 2003

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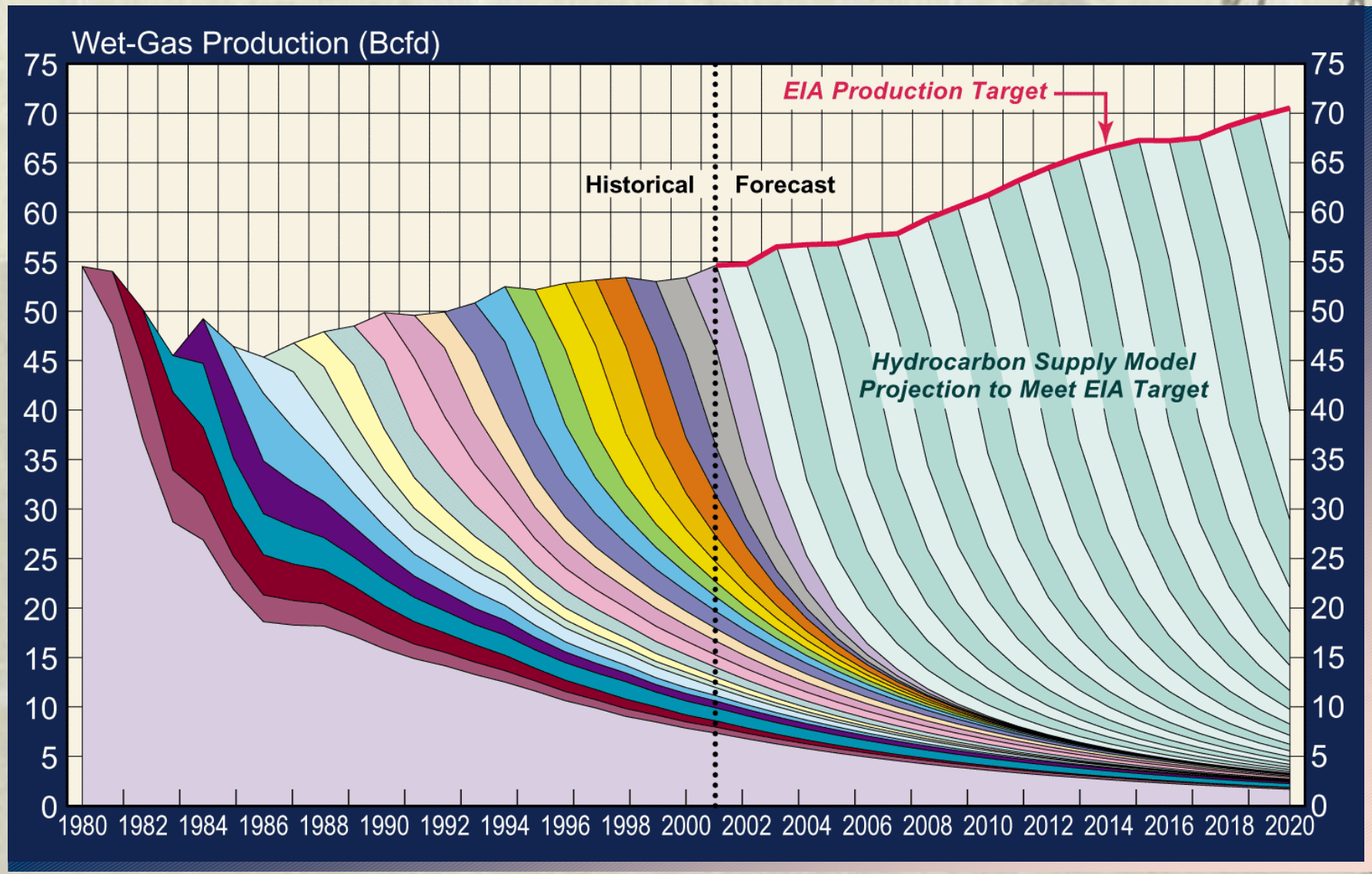

Source: Potential Gas Committee (2003). Data from EIA, Petroleum Information/Dwights LLC (©2002) and D.L. Pierce.

Wish I could leave you on an up note.

Thank you